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THE PROPOSED SCIENCE CENTRE FOR LONDON

IT is now approaching ten years since Sir Henry Dale in his presidential address to the Royal Society raised the question of the need for a national centre of science capable of progressive adjustment to changing needs. Referring to the missed opportunities of the past, largely through Government procrastination, and the congested and unsuitable conditions in which not only the Royal Society but also the Chemical Society and other scientific societies were then housed, Sir Henry claimed that the progressive needs of our scientific societies should be given early consideration in any new allotment which plans for reconstruction might allow. He thus recognized that expansion would of necessity be linked with the reconstruction which the destruction and changes due to the War had necessitated in London as a whole ; but he also added that we ought nevertheless to have a scientific centre permitting scientific societies in Britain to co-ordinate their activities with economy and giving room for change, expansion and organic growth. "We have the further right," he concluded, "to expect that the home of science, in this capital city, will have a dignity symbolizing its value to the nation and the empire, and enabling us to hold up our heads in the company of other countries, whose scientific academies, not more famous than ours, have so long been housed more worthily, and with a more generous recognition of their due place in an enlightened people's scale of cultural values."

That claim for adequate and dignified accommodation for science in the Metropolis has been frankly acknowledged, but it is clear that the nature of the claim is still but imperfectly appreciated, not only by the Government but also by the ordinary citizen. Somewhat more tangible support has indeed been accorded than was received by the earlier schemes which were put forward in 1930 by the late Sir Arnold Wilson, and by Prof. J. F. Thorpe in his presidential address to the Chemical Society. The scheme then proposed contemplated what was described at the time as a certain amount of rationalization of the scientific societies concerned. These included, besides the Chemical Society, the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Society of Chemical Industry, the Institution of Chemical Engineers, the Institution of the Rubber Industry, the Institution of Petroleum Technologists, the Institute of Fuel, the Institute of Metals, the Iron and Steel Institute, the Faraday Society and the Physical Society. All these societies were to be housed under one roof, and their libraries were to be pooled for the common use of their members.

The need for such a scheme had been even then realized, so far as chemistry was concerned, for at least ten if not twenty years, and the central library was one of the chief features of the scheme for the chemical societies, which would have shared two-fifths of the space. Nevertheless, an approach to the

Treasury at the time resulted in a refusal of financial assistance, although the Government expressed sympathy with the scheme. An Association was formed to collect funds and erect and administer a building; but the raising of the necessary £140,000 proved too much for the chemical societies concerned, in the difficult circumstances of the financial depression then prevailing, and the only tangible result has been a larger measure of co-operation between some of the chemical societies themselves.

As a result of Sir Henry Dale's address, however, on October 13, 1944, Mr. C. R. Attlee (Lord President of the Council), Sir John Anderson (Chancellor of the Exchequer) and Lord Portal (Minister of Works) received a very representative deputation from learned societies regarding the needs and claims for accommodation of the societies which aim at promoting the independent advance of the fundamental sciences. The deputation was assured of the interest of the Government, and Sir Henry Dale was asked to submit a quantitative statement of needs. In 1947 the Scientific Societies Accommodation Committee was set up to review the alternative schemes and facilitate a close estimate of the needs of the societies. The idea of extending facilities in Burlington House or its vicinity was abandoned in favour of the conception of a Science Centre; and when on July 7, 1948, a second deputation was received by the Lord President of the Council, the Chancellor of the Exchequer and the Minister of Works, the agreed list of participants included the Biochemical Society, the British Association, the Chemical Society, the Faraday Society, the Geological Society, the Linnean Society, the London Mathematical Society, the Physical Society, the Physiological Society, the Royal Anthropological Institute, the Royal Astronomical Society, the Royal Meteorological Society, the Royal Society, the Royal Statistical Society and the Society of Chemical Industry. It was also understood that many of the smaller scientific clubs and societies would receive hospitality under the new arrangements.

The deputation was much encouraged by its sympathetic reception and was given to understand that the Government was prepared to a[illegible] a site and contribute to the cost of building, but that the building must be the societies' own responsibility. The deputation pointed out that this would involve indefinite postponement, except perhaps for societies having close association with industry, and expressed the hope that the Government would reconsider this attitude and provide the site, the buildings and rent-free accommodation in them. Nevertheless, detailed arrangements were made to carry the project to a further stage, although a particular scheme discussed in negotiations with the Ministry of Works in April 1949 was eventually abandoned.

In the early autumn of 1950 the Royal Society was informed that the scheme for a Science Centre had made great progress. An adequate, central site had been selected and the Treasury had offered to provide the cost of building. On November 21, 1950, Mr. Herbert Morrison, then Lord President of the Council, in reply to questions in the House of Commons by Mr. M. Phillips Price and Sir Wavell Wakefield, stated that since the matter had last been raised on May 5, 1950, the remaining obstacles to the adoption of the Royal Society's long-term proposals had been overcome. Mr. Morrison emphasized that it would be some years before such a centre could be built, but that a start would be made on it as soon as resources could be found, having regard to other urgent claims. Provision would be made for accommodating also within the area the Patent Office and its Library, which would be modernized and extended as a first-rate central reference library on science and technology.

The Lord President added that suitable new quarters would be built for the Royal Society and for other leading scientific societies with their important special libraries, and new offices for the Department of Scientific and Industrial Research and for other Government scientific organizations would also be provided, thus releasing buildings elsewhere and achieving some economies in building requirements. The Centre would be designed to improve facilities and contacts between scientists and users of science, both nationally and internationally. Much detailed planning was still required, but Mr. Morrison said that he hoped to announce the selection of a site early in 1951, although it would be some time before a final scheme could be developed.

The decision that the proposed Science Centre should include provision for a first-class central reference library on science and technology was obviously prompted by the specific recommendation of the Royal Society Scientific Information Conference of June–July 1948, which urged increased support by the United Kingdom Government of central scientific libraries and information services, particularly of the Science Museum Library and the Patent Office Library. In spite of the association of these Government libraries and of the Department of Scientific and Industrial Research with the proposed centre, Sir Robert Robinson, in commending the scheme to the Royal Society in his presidential address on November 30, 1950, was emphatic that there was no evidence of any attempt or desire to undermine the independence of the Royal Society or to make it subservient to any material or political interest. The Lord President of the Council had indicated his full concurrence in the importance of maintaining the prestige and independence of the Royal Society, and in certain conditions for securing this in a Science Centre which had been put before him. The great national value of the Society as a focus of the scientific activity of the Commonwealth was recognized.

No further statement was made by the Government until, in response to a motion by Lord Samuel in the House of Lords on June 11, 1952, asking how the matter stood, the Lord President of the Council, Lord Woolton, gave the assurance that the present Government was in agreement with the statement made by its predecessor on November 21, 1950. No final decision had been made; but Lord Woolton confirmed that a site on the South Bank immediately below Waterloo Bridge and facing Somerset House

had been reserved for a Science Centre by the London County Council, which is the planning authority, and was so reserved in the County of London Plan. Lord Woolton could give no assurance as to when the Science Centre would come into existence; but he pledged himself to use his own influence to ensure that it would eventually be constructed on that site.

Strong support for these proposals has been forthcoming from the Advisory Council on Scientific Policy. In its third report, in July 1950, the Advisory Council noted the finding of the Panel on Technical Information Services of the Committee on Industrial Productivity that the development of technical library facilities in Britain had failed to keep pace with the growth of scientific research, and that in consequence scientific and technical libraries were no longer capable of maintaining full collections of technical literature, and of providing reasonable facilities for readers. The Panel, in its report on Technical Information Services, urged the development of a central reference library in London, if possible in close association with specialized libraries of the learned societies, as well as of a national lending library of science and technology, not necessarily in London.

The Panel itself suggested that the Patent Office Library might form the basis of the proposed central reference library; and, agreeing with the broad objectives stated by the Panel, the Advisory Council constituted a Standing Scientific Library and Technical Information Committee charged, *inter alia*, with co-ordinating the development of scientific libraries as a whole, and considering in greater detail the parts to be played by individual libraries. This Committee eventually reported on the needs of the national library of science and invention which is to form part of the new Science Centre, and in its fourth report, in July 1951, the Advisory Council referred to the action which had been taken in consequence of the Government's announcement of November 21, 1950. It was indicated that the President of the Board of Trade had agreed that the Patent Office Library should be expanded to form the national reference library of science and invention, and that it would continue to serve the needs of the Patent Office. It would cover the whole field of science and would be supported by the specialized libraries of the learned societies. The areas of its responsibility had been agreed with the Research Councils and with the Government Departments principally concerned. Moreover, in conformity with the proposal that the Library should not contain any scientific literature more than about fifty years old, material no longer of value for current work was to be pruned in consultation with the British Museum.

The advisory Council further emphasized that the Library would serve industrial scientists and all those concerned with research and technical development, and would be adjacent to the Department of Scientific and Industrial Research, so that more detailed information services would be available for users. The Advisory Council stated that the Lord President of the Council, Viscount Addison, had approved the report, which had been forwarded to the Ministry of Works for preliminary planning in connexion with the Science Centre.

It is therefore clear that the planning and discussion of the proposed Science Centre had made considerable progress. Yet on December 17 last in the House of Commons, the Minister of Works stated that the scheme has been postponed. Sir Wavell Wakefield had inquired as to the present position with regard to the Science Centre, and whether it was intended that the necessary buildings should be erected on the South Bank site. Mr. Eccles replied that the planning of the Science Centre had had to be deferred in view of the need for economies, and that when the economic situation improved it was hoped to lease a site on the South Bank immediately below Waterloo Bridge.

That this bland reply was received in the House of Commons apparently without protest demonstrates how far not merely the Government but also the House of Commons is from any real appreciation of the importance of science and technology in the national economy, or of the conditions in which both science and technology are nurtured. It is disheartening enough that once again the plans and hopes of a decade should be jettisoned without result; nor can that jettisoning be regarded as other than waste and false economy. For it must be noted that Mr. Eccles stated expressly that the planning itself—not the actual construction—had been deferred.

That in itself is discouraging enough, for no one who has been associated with what has been done, ever since the Royal Society Scientific Information Conference in 1948, can fail to realize the far-reaching repercussions of such a decision and the frustration which must result in many different fields. The record of disappointments which have attended the efforts of the Royal Society over the past century to obtain a worthy home and adequate accommodation, and which Sir Henry Dale recapitulated more than ten years ago, is well calculated to prejudice any fresh effort. It makes it hard to believe in the sincerity of any fresh government approach "when the economic situation improves".

That, however, is not all. The project for a Science Centre was intended not merely to provide a dignified home for the Royal Society and other scientific societies: it was also intended to further their more efficient and economic functioning. Thus the financial difficulties which threaten the continuation of the Bureau of Chemical Abstracts might have been considerably less acute, and the call for Government assistance much slighter, if indeed made at all. Furthermore, even so far as already elaborated under the Advisory Council for Scientific Policy, the project appears to offer some advantages and savings in the operation of the Department of Scientific and Industrial Research without detriment to its efficiency.

The real objection to the postponement of the scheme is its adverse effect on the advance of science and technology upon which the economic recovery and survival of Great Britain so largely depend. That

dependence has been admitted by Government spokesmen and others, who have insisted that the first need is to secure the effective utilization of existing knowledge, and have recognized, too, the dependence of such utilization upon the effective dissemination of scientific and technical information. The proposal for a national reference library of science and technology, which forms an essential part of the scheme, and which was intended to relieve the congested conditions which at present hinder the efficient use of the library of the Chemical Society and others, was a step to that end long overdue.

The Department of Scientific and Industrial Research has already re-orientated its policy so as to encourage the more effective dissemination of both scientific and technical information, and thus made the need for such a central library more urgent. Moreover, while Governments have procrastinated, the outflow of scientific and technical literature throughout the world does not stop but rather increases. Libraries which were overtaxed ten years ago are still more overstrained to-day: conditions and expedients, which could be accepted for a short period while plans for adequate accommodation were being formulated, become intolerable when delay is indefinite.

Now the whole scheme is in abeyance. It may be that economic conditions, on a short-term view, are so serious that immediate action on the scheme is impossible, in spite of its importance for the future of science and technology in Britain. Having proceeded thus far, however, every opportunity must be taken to remind the government of the day of its existence—and of its vital importance.

A BOTANIST'S QUO VADIS: INTEGRATION OR SPECIALIZATION

Phylogeny and Morphogenesis

Contemporary Aspects of Botanical Science. By Prof. C. W. Wardlaw. Pp. viii+536. (London: Macmillan and Co., Ltd., 1952.) 42*s*. net.

MANY of those who belong to the older generation of biologists may recognize in biology at the present time something of the welter of confusion in aims and ideas that marked the similar period after the First World War. It is therefore an appropriate moment to ask whether we are going to witness another transformation in the climate of biological thought similar to that which overtook the biological subjects after 1920. Revolution in techniques is obviously taking place. Will this produce a generation of botanical specialists, or is it possible to offer an idea which will serve to integrate further advances? At such a time it is stimulating to receive a book by an eminent botanist which looks at the present position and attempts to resolve it.

Prof. Wardlaw's central position is that of a morphologist and, as his title indicates, he sees in phylogeny and morphogenesis twin aspects of a unified treatment of plant form which may serve as a focal point for further botanical developments. His detailed consideration of these matters, ranging over a wide field, starts with the comparative study of the phylogeny of ferns and other pteridophytes (as suggestive examples). This leads to a consideration of the morphology and origin of leafy shoots and the questions associated with the origin of a land flora. The antithesis of this comparative treatment is next developed—the idea of causal morphology leading to the developmental study of morphogenesis. Three chapters deal with the influence of genes on the development of form; then come three more chapters devoted to biochemical aspects of this problem. There follows an inquiry into the physical and mathematical considerations involved, and this leads to a survey of experimental studies on morphogenesis in which the author's own work on ferns figures prominently.

The point of view adopted is thus that morphogenetic processes have necessarily a genetical basis. The primary action of genetical factors upon growing cells is held to be biochemical in nature; but simultaneously, and often as a direct consequence, physical factors become operative and are largely involved in the detailed determination of form and structure in the tissues. But because form is regarded as a product of evolution, it follows that the findings of phylogeny and of the comparative method will be of advantage to the morphogenetist, just as enhanced knowledge of morphogenesis must lead to a better understanding of phylogeny.

Prof. Wardlaw thus suggests that, while contemporary botanical science is feeling boldly in a number of directions, this does not mean that its students must necessarily become more specialized and its study more dispersed. He clearly sees the possibility of integrating these diverse lines of advance around the twin subjects of phylogeny and morphogenesis. This is not very far away from the late-Victorian doctrine that the study of evolution should be the main motive underlying biological research, although no doubt the emphasis is now placed differently. In particular, the morphological consequences of this doctrine are restated in modern terminology and in the light of modern work. It is clearly impossible to say how this point of view may represent the future of botany. A majority of present-day students of this subject appear to have a greater interest in the *processes* by which the living organism functions than in its form. For this reason the dynamic aspects of morphogenesis are likely to prove more popular than the comparative. Thus growth and organization, which are essentially dynamic and which we can study as existing processes, are beginning to attract more attention than evolution as the fundamental properties of living organisms. If so, it is around these that it may prove possible to integrate the future of botany, whatever an individual's special field of interest may be. This, at least, might well be an alternative statement of the note on which this book ends.

It would be unusual in a work of this type if the specialist in any section of the vast and diversified field surveyed could not find some point of criticism. It would be unjust to direct attention to these in a short review without being able to survey in much greater detail the wealth of information the book contains. It must suffice to say that such a book has been greatly needed. Its publication will stimulate thought and inquiry in a fundamental field.

W. H. Pearsall

PREHISTORY IN AFRICA

Proceedings of the Pan-African Congress on Prehistory, 1947

Edited by L. S. B. Leakey, assisted by Sonia Cole. Pp. viii+239. (Oxford: Basil Blackwell, 1952.) 35s. net.

UNTIL about the second decade of the present century the study of early prehistory was mainly confined to Europe, more particularly to the western regions. Later, as a result of the brilliant researches of a number of prehistorians, the importance of Africa to the subject has been more and more realized. Investigators in all parts of the continent have made discoveries of great interest, and these cannot always be fitted into the narrow framework of the scheme of development created by the prehistorians in western Europe.

Dr. L. S. B. Leakey, a former pupil of the Cambridge school of archæology, fully realized this situation; but the outbreak of the Second World War delayed any action, and it was not until its conclusion that he determined to call a Congress, held in Nairobi in 1947, to discuss the various early archæological problems in the African continent. Maybe it was a pity the Congress was called so soon after the War; if it had been summoned a year, or even two years, later many more prehistorians from many more countries would have been able to attend. When important decisions are to be taken, it is well to have more delegates present than were able to be at Nairobi so soon after the close of hostilities; only now has it been possible to produce the proceedings, and most of the papers appear in a very attenuated form. Shortage of paper and expense were, of course, the reasons.

Roughly speaking, the work of the Congress came under three headings: papers dealing with aspects of geology, general palæontology and climatology; papers on human palæontology; and papers on prehistoric archæology. Obviously, before a stone-age culture can be properly understood, the conditions under which it flourished must be known, and this involves questions of Quaternary geology and palæontology. Prof. C. Arambourg contributes two papers on "African Pleistocene Mammals" and "The Red Beds of the Mediterranean"; and there is a paper, with many diagrams, on "Pleistocene Climate Changes in East Africa" by Dr. E. Nilsson. There are also papers by Abbé H. Breuil, Prof. F. Zeuner and Dr. A. Ruhlmann. The section of the Congress on human palæontology is nowadays perhaps a little out of date, as the study of early man himself and his precursors in Africa has been going ahead by leaps and bounds. But the facts as known at the time are duly set out in a number of papers by the late Dr. R. Broom, Prof. W. E. le Gros Clark, Prof. R. Dart and others. The final section contains papers on various industries and cultures. Dr. Desmond Clark writes on Somaliland; but shortly his book on this interesting region will be published, and we shall have his work there set before us in detail. The problem of the so-called Tumbian culture in the Congo is discussed by Dr. F. Cabu and Dr. Leakey, and there are also, among many other contributions, papers from Dr. B. D. Malan on "The Final Stages of the Middle Stone Age in South Africa" and by Dr. S. A. Huzayyin on the "Upper Palæolithic of Egypt".

The volume is, of course, of first-class importance to any prehistorian interested in Africa. It is only such a pity that factors outside the control of the editors have so delayed its publication. It is to be hoped that the proceedings of the Second Congress, held recently in Algiers, will see the light of day rather more speedily.

MILES BURKITT

PSYCHOSURGICAL STUDIES AT THE GREYSTONE HOSPITAL

Psychosurgical Problems

By the Columbia Greystone Associates, Second Group. Dr. Fred A. Mettler, Editor. Pp. xii+357. (London: Routledge and Kegan Paul, Ltd., 1952.) 42s. net.

THIS book is a second report of the work carried out by a research team known as the Columbia Greystone Associates. The first report by this group, called "Selective Partial Ablation of the Frontal Lobes", dealt with various biological, psychiatric and psychological effects of psychosurgery (particularly topectomy) as applied to psychiatric subjects. The present volume reports a similar study into the after-effects of various less commonly employed psychosurgical procedures (notably cortical, venous, ligation and thermocoagulation).

The seventeen chapters of "Psychosurgical Problems" are written by psychiatrists, psychologists, neurologists, physiologists and other experts in various medical fields, whose names are well known within their specialties. Starting with a general survey of the project and a consideration of the special setting within the Greystone Hospital, the writers take up in turn the surgical procedures employed, general medical findings, neurological findings, vestibular functions and, for the remaining two-thirds of the book, psychological studies. All these contributions are clearly written, scholarly and well presented. Nevertheless, the reader is likely to lay down the book with a feeling of disappointment. In the first place, the number of cases included is rather small; including control subjects, we are dealing only with about thirty patients in all. It may be doubted whether such a small number which, it should be remembered, has to be sub-divided again because of the different operations carried out, really justifies such detailed reporting. In the nature of the case, only very gross changes could be expected to exceed reasonable criteria of statistical significance, and such gross changes would scarcely have required the setting-up of such tremendous experimental apparatus.

In the second place, the reader will find that in this study, as in the one preceding it, conclusions are mainly negative; that is to say, the research workers failed to find changes after the operation in the various areas investigated. It is, of course, possible that surgical interference with the frontal lobes has only very slight and negligible effects on personality, but it is doubtful if such a hypothesis would seriously be entertained by most workers familiar with the field.

The dearth of positive findings is much more likely to be due to a fundamental weakness of this whole endeavour. There is no underlying theory according to which investigations were carried out and procedures selected; there does not even seem to have been a set of guiding hypotheses, the disproval of which might have advanced the study of the field.

The Columbia Greystone Associates seem to have proceeded throughout in a spirit of empiricism which selects tests and procedures without the benefit of theory. This must be held responsible for the failure of the whole experiment to give positive results; as A. Petrie has shown in Great Britain, suitable choice of theoretical concepts and the selection of experimental techniques based on such theory can uncover strongly marked changes after psychosurgery.

On the whole, then, we may conclude that while this book is of undoubted interest to the specialist and will be read widely by those professionally interested in psychosurgery, the contribution it makes to scientific knowledge is relatively small.

H. J. Eysenck

SAND- AND WATER-CULTURE OF PLANTS

Sand and Water Culture Methods used in the Study of Plant Nutrition

By Dr. E. J. Hewitt. (Commonwealth Bureau of Horticulture and Plantation Crops: Technical Communication No. 22.) Pp. x+241+9 plates. (Farnham Royal: Commonwealth Agricultural Bureaux, 1952.) 42*s*.

THE first recorded use of the water-culture method for the growing of plants was that of Woodward, who in 1699 grew potatoes, vetches and mint in water from springs, wells, rain and distillation. Sixty years later Duhamel du Monceau grew tree seedlings in filtered water from the Seine; but it was not until 1804 that the first controlled water-culture experiments were attempted, by De Saussure in France. He was the first to show that nitrates were necessary for growth and that differential absorption of solutes was usual. The method of sand culture was introduced by Boussingault in 1851 and greatly extended by Salm-Horstmar, who, even at that early date, used a technique sufficiently refined to show the essential nature of manganese and iron as well as the 'macronutrients' for plant growth.

Since the time of these early workers, more and more elaborate and precise techniques have been evolved by hundreds of workers in the field of plant nutrition. In the investigation of the roles of the 'micronutrients' or 'trace elements' in plant physiology, and even more in the study of the interrelations of nutrients, small details in the purification of growing-media or nutrient solution, in the preparation of containers, or in the protection of the cultures from chance contamination, may be of vital importance. Any new worker in the field must therefore make himself familiar with the experience of many hundreds before him to be sure that he has missed no point essential to his proposed technique.

In this task Dr. E. J. Hewitt's book will be of quite inestimable value. He has brought together in one volume a prodigious amount of detailed information, critically reviewed, from a literature of some eleven hundred titles. No aspect of the subject escapes minute attention, and the author throws his net wide enough to include even methods for the control of the environment in plant chambers and the design and interpretation of experiments. In the second part of the book, Dr. Hewitt gives a detailed account of the special technique developed at the Long Ashton Research Station, mainly by himself, for large-scale sand culture in pots, an illustration of the perfection achieved by learning from the experience of others.

Few reviews of literature have been so exhaustive, informative and valuable as this, and the author and the Commonwealth Bureau are to be congratulated on the production of a book which will save research workers many weary hours of searching through original papers.

R. H. Stoughton

A PSYCHIATRIST'S CREDO

Speaking of Man

By Dr. Abraham Myerson. Pp. 255. (London: Martin Secker and Warburg, Ltd., 1952.) 15*s*. net.

THIS is not a serious scientific contribution but a collection of essays loosely linked together, describing the author's views on life and mankind. The style varies and is sometimes grave and erudite, and at others slangy and cynical. Yet invariably the personality of the author permeates the whole and shows him as a witty cynic.

Abraham Myerson was a New England neuropsychiatrist who was a student of Morton Prince and became his life-long friend. He was later elected assistant professor of neurology at Tufts Medical School, and after three years was made professor. Warren Stearns, a former dear of the School, said that the large number of students who specialized in neurology did so because of the popularity of Myerson's teaching.

The most important work which he performed was his investigation into the inheritance of mental diseases and upon which he published one of his numerous books. He did not limit himself to one section of psychiatry, however; but his endless curiosity compelled him to study everything from the neuroses of the nervous housewife to sleeping and waking mechanisms.

It is surprising that Myerson should have written so vigorously in this book when one considers that a great deal of it was produced when he was very near death from heart-block. The chapter headings show the type of material upon which he writes: on the worth of living; my father and I discuss matters; my prejudices and prepossessions; woman, the authorities' scapegoat; the liabilities of language; heredity and environment; the great unlearning; the low-down on authorities, including psychiatrists; genius; sterilization; desire and mental health; body and mind; concerning intelligence; etc.

As these essays show, Myerson was essentially broad-minded. It is said that, although he did not believe in psychoanalysis, he made no objection when his son wished to study it. This appears in his attitude to psychiatry, demonstrated by two of his aphorisms: "The physiological approach to the neuroses does not exclude nor minimise the importance of a complete understanding of the psychological life of the individual"; and "Scientific psychiatry should be sceptical, humble, and experimental".

Those who read this book will enjoy the distilled wisdom and wit of one who regarded everything with scepticism, yet who was strongly on the side of truth and who hated pompous inaccuracies.

Clifford Allen

The Terpenes

By Sir John Simonsen and Dr. D. H. R. Barton. Second edition. Vol. 3: The Sesquiterpenes, Diterpenes and their Derivatives. With addenda to Vols. 1 and 2, by Sir John Simonsen and Dr. L. N. Owen. Pp. xi+579. (Cambridge: At the University Press, 1952.) 50*s*. net.

THE publication of this volume brings to a successful conclusion the arduous task of issuing a second edition of a work that has become a classic in terpene chemistry (see *Nature*, 160, 384; 1947). The vigorous growth of this field of organic chemistry since 1931–32, the date of the original edition, is reflected in the expansion of the second edition from two to three volumes, totalling some seventeen hundred pages. The subject-matter of the original second volume has now been conveniently sub-divided into "Dicyclic Terpenes" (Vol. 2) and "Sesquiterpenes and Diterpenes" (Vol. 3). In the preparation of the new edition Sir John Simonsen has been fortunate in enlisting the general help of Dr. L. N. Owen and Dr. D. H. R. Barton, together with special aid from Prof. W. Cocker in preparing an account of santonin.

The third volume incorporates a review of the important literature up to 1949, and contains some references to 1950; moreover, it includes addenda bringing the matter of the first two volumes up to date. Among the interesting subjects dealt with in this supplement are recent studies on the *iso*propenyl–*iso*propylidene controversy, and a review of the evidence which shows that irone must now be recognized as 6-methyl-ionone, capable of existing in α-, β- and γ-forms, each corresponding to several stereoisomeric modifications. That terpene chemistry still has much to offer to the investigator is shown *inter alia* by the current researches of Ruzicka and his collaborators at Zurich and also by the interesting lists given in the work here under review of compounds of various types, the constitutions of which still await elucidation.

The attractive format and the remarkably clear type and formulæ of the first edition have been reproduced in the new publication. From every point of view this is a major work of the first class, which is certain to receive the warm welcome it deserves.

JOHN READ

Linear Transformations in *n*-Dimensional Vector Space

An Introduction to the Theory of Hilbert Space. By Prof. H. L. Hamburger and M. E. Grimshaw. Pp. x+195. (Cambridge: At the University Press, 1951.) 25*s*. net.

THE concept of space of infinitely many dimensions, effectively introduced about fifty years ago by Hilbert in connexion with integral equations, co-ordinates and elucidates many of the problems in mathematics and mathematical physics in which linear operators are involved. Prof. H. L. Hamburger and Miss M. E. Grimshaw have provided a useful prolegomenon to this doctrine; they deal with analogous problems in *n*-dimensional linear space, particularly the study of canonical forms of transformations, but they choose, wherever possible, methods which will also serve for Hilbert space. The arguments are crisp but austere, even in this simpler field, and they are mainly algebraic, although Hilbert's variational method for the eigen-values of a Hermitian form is included. Recently obtained inequalities due to Aronszajn indicate an application to the numerical calculation of eigen-values; and the reduction to canonical form of a pencil of operators is illustrated by a detailed study of the familiar dynamical problem of small oscillations.

The topic is abstract, and the arguments, even when geometrical language is used, demand close attention; but the precision with which these powerful methods operate is worth an effort to acquire. It is to be hoped that the authors will produce a sequel in which the methods are shown at work in Hilbert space.

The Higher Arithmetic

An Introduction to the Theory of Numbers. By Prof. H. Davenport. Pp. 172. (London: Hutchinson's Scientific Library, 1952.) 8*s*. 6*d*. net.

MOST mathematicians, amateur and professional, find the theory of numbers fascinating. Prof. H. Davenport, in his concise, self-contained account, deals with factorization and the primes, congruences, quadratic residues, continued fractions, sums of squares, quadratic forms, and some Diophantine equations. His complete mastery of the field has helped him to give a clear, forward-looking and thoroughly up-to-date exposition. In number theory, results may often be easy to guess but difficult to prove, yet guess-work without proof is almost worthless. Davenport's rigour of demonstration, demanded by the nature of the subject, is always lucid, but it requires the reader's close co-operation, often with pencil and paper; the well-chosen numerical examples, with which the author illuminates practically every step, help to concentrate attention. Little previous knowledge is assumed, but by sticking fairly closely to main themes, the author brings his reader near to the present bounds of knowledge and indicates some of the likely lines for further progress. The novice who wishes to pay his respects to the 'Queen of Mathematics' will be wise to choose Prof. Davenport's presentation.

Botany

By Prof. Carl L. Wilson. Pp. xi+483. (New York: The Dryden Press, 1952.) 6.10 dollars.

THIS attractive book, intended primarily as an introduction to botany for students in American colleges, succeeds admirably in presenting the elements of the subject in a most agreeable and refreshing manner. The first half of the book follows the normal pattern of botanical text-books by dealing with the structure and physiology of the higher plants. It is noteworthy to find such topics as vegetative reproduction, erosion, food poisoning, hay fever plants, growth substances, viruses and antibiotics introduced in this elementary treatment. The later chapters cover a wide survey of the whole plant kingdom with outline classifications of the various groups and details of significant life-histories. The account of early land plants and their evolution is particularly well written and illustrated.

Each chapter is prefaced with a brief and sometimes historical introduction to the contents and concludes with a useful summary. As may be expected, the examples selected for study are those readily available to American students, and the predominant emphasis is on the vegetation of North America. In spite of this, Prof. Wilson has produced a most stimulating text-book which should be read and enjoyed by students and laymen alike.

There are many photographic illustrations, and special praise must be given to Dr. Hannah Croasdale for the clear and convincing diagrams and figures.

DISLOCATIONS AND THE THEORY OF SOLIDS*

By Prof. N. F. MOTT, F.R.S.
H. H. Wills Physical Laboratory, University of Bristol

A DISLOCATION is the name given to a particular type of defect in a crystalline solid. The concept was introduced into physics by Taylor[1] and others[2,3] in 1934 in a first attempt to devise a mechanism on the atomic scale to describe plastic flow. Since the Second World War, the theory has developed rapidly, and, apart from its applications to flow of crystalline materials and to strain-hardening, it is of importance for the understanding of crystal growth, grain boundaries and also chemical reactions in solids. The aim of this article is to outline these developments; for a description of some of the properties of dislocations the reader should consult the reviews of, for example, Cottrell[4], Nabarro[5] and Mott[6,7].

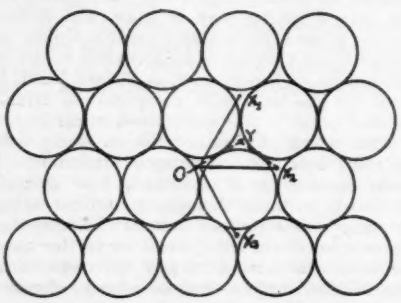

Fig. 1. Close-packed plane of a face-centred or hexagonal crystal, showing the three possible Burgers vectors, OX_1, OX_2, OX_3. OY represents the vector for a 'half dislocation'

A dislocation is a line discontinuity which must either form a closed loop or end on the surface of a crystal. If it lies in a slip plane, it can be defined as the line separating the part of the material that has slipped from that which has not. A dislocation is characterized by its Burgers vector, which represents the distance through which the slip has occurred. Thus, for a close-packed cubic slipping on the (111) planes, there are three possible Burgers vectors, as shown in Fig. 1. Figs. 2 and 3 show the two main types of dislocation, the edge and screw, though intermediate and other types are possible. In the edge type the Burgers vector is perpendicular to the dislocation line, which means that the dislocation line can move only in the plane containing both, whereas the screw, for which the two are parallel, can switch from one plane to another. This has important consequences for the theory of cross-slip (cf. ref. 7).

It will be seen from Figs. 2 and 3 that the crystals are shown as having steps on the surface, and that where a screw dislocation meets the surface a step necessarily ends. Now, on straining a metal crystal or a grain of a polycrystalline metal, steps of just this type are formed, which are frequently observed to terminate. These steps are called 'slip lines', and their height is usually about a thousand lattice spacings, though recent work has shown that steps of much smaller height can be formed[8], especially in creep[9], and by using special techniques slip lines one lattice parameter high have recently been observed on silver crystals[10]. (Steps of much greater height have been shown[11–13] to consist of 'clusters' of elementary lines close together.) So we must distinguish between the elementary (screw) dislocations which terminate at the end of a step one lattice parameter high, and the strong dislocations or groups of 'piled-up' dislocations[14] which mark the end of a slip line of the normal type.

Any theory of plastic flow and of the formation of slip lines starts from the assumption that the annealed material contains dislocations, and it is first necessary to review the evidence for this. First of all, any evidence that a crystal has a mosaic structure can now be interpreted in this sense; a mosaic boundary —or boundary of a polygonized cell—can be analysed into a row of dislocations. This is well shown by the bubble rafts developed by Bragg and by Lomer and Nye[15], of which an example is shown in Fig. 4. Arising out of this concept, many calculations have been made[16,17] of the energies of grain boundaries and mosaic boundaries as a function of the angle between the grains. This approach gives values in very good agreement with experiment, even for angles such that, as Fig. 4 shows, the analysis into dislocations is no longer valid.

Secondly, there is the now well-known evidence from observations of crystal growth (for a review see ref. 18). When crystals are formed from vapours or from solution, they frequently grow by the rotation of a step, such as that of Fig. 3, about the point A where it terminates on a screw dislocation. This mechanism was first proposed by Frank, who showed that the join of the step to the surface would not remain straight but would curl up into a spiral. Since then, spirals have been observed on a large number of crystals[18], and in the case of cadmium iodide growing from solution it has been possible to prepare a film showing the rotation. On cadmium iodide the step—now called a growth step—is several hundred lattice parameters high and, like slip bands on solids, is easily visible under the microscope. On paraffin crystals grown from solution, the height is the length of the paraffin molecule, and, after gold shadowing, the steps are visible with the electron microscope by direct transmission. The much smaller monomolecular steps on beryl, magnesium[19] and silver[10] are visible by means of the optical microscope only because of the 'decoration' of the line of the step by a row of etch pits in the case of beryl[20], and in the case of the metals by a ridge, probably of sulphide, which forms when the metal surface is left for some hours in the presence of 'Plasticine'. Growth steps are thus reactive regions and should be of importance in surface chemistry.

Some of the recent successes of the work on crystal growth have been: the explanation of polytypism on silicon carbide[21]; the prediction that, when growth is by the rotation of a step of considerable height, the centre of the screw dislocation would be a

* Based on three special lectures delivered in the University of London on Nov. 27, Dec. 4 and 11.

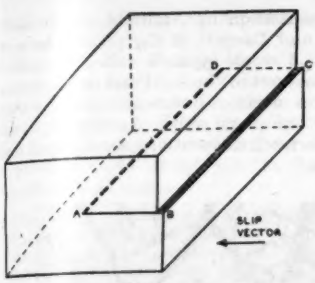

Fig. 2

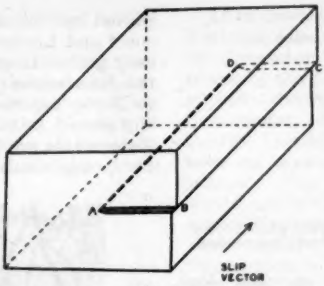

Fig. 3

Fig. 2. An edge dislocation (*AD*). Note the step *BC* on the surface of the crystal
Fig. 3. A screw dislocation (*AD*). Note that the steps *BA*, *CD* terminate at the end-points of the dislocation
These diagrams are reproduced by permission from "Crystal Dislocations", by W. T. Read (McGraw-Hill Book Co., Inc., 1953.)

cylindrical hole, and also the observation[22] of such a hole in cadmium iodide; and the observation on beryl[23], on paraffins (cf. Fig. 6) and on metals[10] of patterns of the types of Fig. 5. In the case of these observations, they show that, after growth has finished, the screw dislocation on which the growth spiral was locked has moved. They thus give direct evidence that dislocations can move, and represent, to my knowledge, the first observation of slip lines of height equal to one atomic or molecular spacing.

The whole phenomenon of crystal growth gives some clue as to why crystals contain dislocations, since according to this model it is impossible for a crystal to grow unless it contains at least one screw dislocation, which may be formed when the crystal nucleates on some foreign body. It is by no means suggested, however, that this is the only origin of dislocations. Seitz[24] has suggested that they may form by the condensation of vacant lattice-sites as a crystal is cooled, and Teghtsoonian and Chalmers[25] have shown that something of the sort occurs when metals grow from the melt. Also, it is not believed impossible in principle to prepare a crystal without dislocations; Fig. 6 shows a paraffin crystal prepared and photographed by Dawson and Vand which has grown on two screw dislocations of opposite sign; these, after growth was complete, have moved together under their mutual attraction and annihilated one another. This crystal contains at any rate no screw dislocations.

Perhaps the most direct evidence of the existence of dislocations comes from the recent success of J. W. Mitchell[26] in getting photolytic silver to separate out along dislocation lines in a transparent crystal, silver bromide, which has been slightly strained and then annealed. One of his photographs is shown in Fig. 7. The hexagonal form of the dislocation network was predicted two years earlier, following a suggestion by Frank, in a lecture by me[7]. It arises because, as Fig. 1 shows, the three possible Burgers vectors in the face-centred cubic add up to zero, so that three dislocations can meet in a point. This work is at present in its infancy, and promises to give much valuable information.

We turn now to the phenomenon for the description of which dislocations were invented—namely, plastic deformation of crystalline solids. The first two questions to be answered in this field are: Why is slip usually concentrated on relatively few active planes, giving the visible slip lines on the surface, and why do metal crystals deform for stresses so much below the theoretical stress? Both questions are answered by the model of Frank and Read[27], of which several further accounts have appeared in the literature[5–7]. These workers show that a dislocation line which is terminated at its two ends—for example, in the way in which the elements of the network of Fig. 7 are terminated—will, when the material is stressed, produce an indefinite number of 'dislocation rings' which can spread out to the surface of the crystal, there producing a slip line. Thus any of the segments of the network shown in Fig. 7 is capable of acting as one of these 'Frank–Read sources'. If l is the length of one of the segments, the stress required to produce slip is shown to be Gb/l, where G is the shear modulus of the material and b the Burgers vector. Values of l of the order 10^{-4} cm. give agreement with experiment for the yield stress of single crystals. This is of the order of the distance usually assumed between dislocations or mosaic boundaries.

In materials other than pure annealed metals the resistance to flow is due to three causes as follows. (1) The locking effect of impurities which diffuse to the dislocations and are trapped there[28,29] (Cottrell locking). This effect is particularly marked in the case of interstitial impurities in body-centred metals. In many cases it leads to a sharp but temperature-dependent yield point and is probably connected with the phenomenon of notch brittleness. (2) Internal strains due to precipitates or 'Preston–Guinier zones'. These strains impede the movement of dislocations. Much less dependence on temperature is expected[30] than for Cottrell locking. (3) Internal strains due to cold working.

When a cubic metal is strained at a fairly low temperature, the number of slip-lines observed

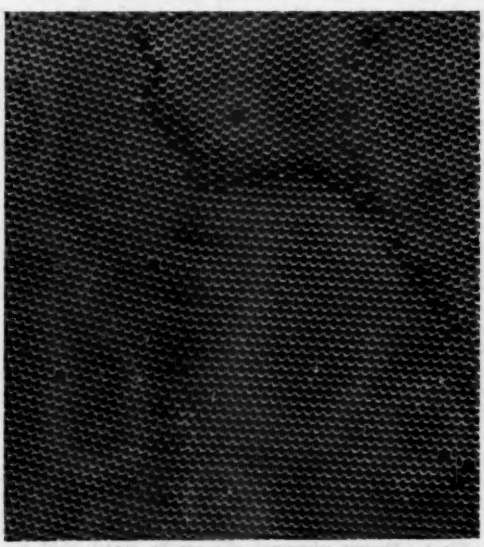

Fig. 4. A bubble raft, showing a polygonized boundary (row of edge dislocations), a large-angle grain boundary and vacant lattice-sites (Lomer)

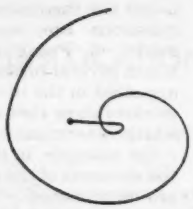

Fig. 5. The type of step on the surface of a crystal which occurs when the screw dislocation has moved after growth has finished

increases, but the amount of slip on each does not. Both I[7] and Fisher, Hart and Pry[31] have deduced from this that the operation of the Frank–Read source is a dynamic process, the dislocations moving with a speed near that of sound and their own momentum keeping the process going until about a thousand dislocation rings are produced; the stress due to these dislocations then stops the action of the source. With this model the formation of a slip line takes about a microsecond ($1{,}000\ l/c$, where c is the velocity of sound), after which its height does not increase, although its length may (Chen and Pond[32]).

When a slip line terminates within a solid, there must be present, as already emphasized, regions of very high strain, where about a thousand dislocations are piled up together. The properties of these groups have been worked out by Eshelby, Frank and Nabarro[14]. According to Stroh[33] they contain the main part of the stored energy. I have ascribed the work-hardening of cubic metals to the strains produced by these groups[6], and my model is similar to that of Taylor[1], except in the following respects: the random internal strain is due to a relatively small number of strong groups instead of a large number of isolated dislocations; and a mechanism is proposed for locking the groups in position. This is based on the demonstration by Lomer[34] and Cottrell[35] that, in the face-centred cubic, dislocations moving on octahedral planes inclined at an angle to each other can combine to form the so-called sessile or immobile dislocations. This observation is supported by the observation by Andrade and Henderson[36] and Lücke and Lange[37] of the phenomenon of easy glide. In good single crystals suitably oriented the dislocations pass out of the solid and no hardening or X-ray asterisms occur; but a condition is that slip should be on one plane only. As soon as sessile dislocations are formed, dislocations are trapped and hardening results.

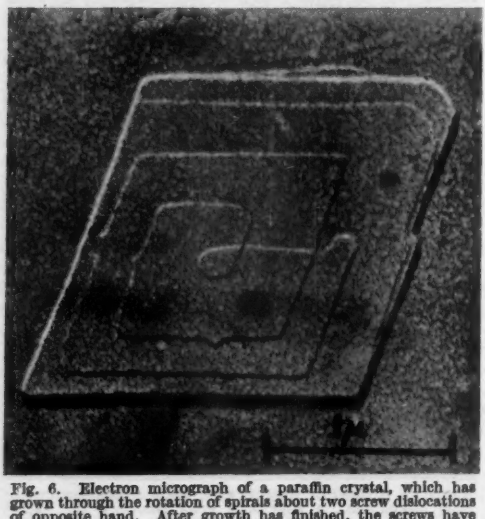

Fig. 6. Electron micrograph of a paraffin crystal, which has grown through the rotation of spirals about two screw dislocations of opposite hand. After growth has finished, the screws have moved together and annihilated each other (Dawson and Vand)

Fig. 7. Dislocation networks in silver bromide. These are formed by a small strain followed by an anneal, and are made visible by exposure to light, which precipitates silver along the dislocation lines (J. W. Mitchell)

Thermal recovery is to be ascribed to the break-up of the piled-up groups of dislocations. To escape from such a group, edge dislocations must 'climb' or leave their slip planes. To do this they must absorb or give off vacant lattice-sites, and the process is thus associated with self-diffusion, which also is believed to occur through the agency of vacancies. Owing to the very great stresses in the piled-up groups, however, the activation energy for 'climb' decreases with increased cold work, and may be less than for self-diffusion[7]. The sensitiveness of recovery to purity is to be explained by the ease with which diffusion of an impurity to the piled-up groups may diminish these stresses.

After escaping from the piled-up groups, some of the dislocations of opposite sign may annihilate each other, but most form polygon boundaries. This must be thought of as a secondary process; the essential process for recovery is the dissolution of the piled-up groups.

The vacancies normally responsible for recovery and for self-diffusion are those formed by thermal agitation. There is now much evidence, however, that cold work itself produces vacancies[38–40]. To this may be described the increased rate of diffusion in some alloys which can be observed after cold work, just as after bombardment by fast particles[41], which also produces vacancies. Following Brown[12], I have suggested[6] that vacancies formed near a slip line can cause some sort of local annealing, and so account for the fact, first pointed out by Heidenreich and Shockley[11] and by Brown[12,13], that, after the formation of one elementary slip line, if the temperature is not too low, others are formed very near it, often at

a distance difficult to separate with the optical microscope.

In conclusion, it may be said that there is now strong evidence for the existence of dislocations, and powerful experimental methods exist for studying their properties. With the help of this concept, it has been possible to account for some of the most important facts about plastic flow, though much remains to be done.

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CHINESE SCIENCE REVISITED (I)

By Dr. JOSEPH NEEDHAM, F.R.S.

DURING the period of the Second World War I had the good fortune to be sent to China with the mission of rendering all assistance possible to Chinese science and technology in its difficult position of blockade. At that time, Chinese scientists were working under many difficulties and with great devotion in the remoter parts of the country, where institutions of learning and production had been set up out of reach of the Japanese. Last year I was able to take advantage of another invitation which enabled me to spend the summer in China. Since circumstances have of late impeded the flow of news between the two countries, it may well be that some information concerning Chinese science and scientists to-day will be welcome to readers of *Nature*.

After twenty-one years of useful life, the Chinese National Academy (Academia Sinica) was re-founded on November 1, 1949, following the assumption of power by the present Government of the Republic. It is placed directly under the Cultural and Educational Commission of the Administrative Council of the Central People's Government, one of the five Commissions stemming directly from the Council or cabinet. The president of the Academy, Dr. Kuo Mo-Jo, one of China's leading historical archæologists, is also chairman of this Commission and one of the Vice-Premiers. Similarly, the vice-chairman of the Commission is also one of the vice-presidents of the Academy, Mr. Ch'en Po-Ta. The other vice-presidents are also well-known men: Dr. Li Ssu-Kuang (geology); Dr. T'ao Mêng-Ho (sociology); Dr. Chu K'o-Chen (meteorology); and Dr. Wu Yu-Hsün (physics).

The recognition of science as basic to the life of the nation is written into the Common Programme of the Chinese People's Political Consultative Conference. Art. 41 states that the education of the country shall be "new and democratic—i.e. national, scientific and popular". Art. 43 says that "efforts shall be made to develop the natural sciences in order to serve industrial, agricultural, and national defence construction. Scientific discoveries and inventions shall be encouraged and rewarded, and scientific knowledge shall be disseminated among the people". The Academy now works along lines which are the consequences of these conceptions and in harmony with the general ideals of the Government. Science is recognized to have close connexions with the needs of the people, and a great effort has been made to overcome the planlessness of former days. While the main task of the Academy is scientific research as such, it gives much assistance in the training of technical personnel. As a government institution, moreover, it advises government departments on scientific matters, and renders assistance in construction works which are proceeding all over the country.

From the beginning of its life, the Academy possessed central research institutes of its own, and was never a purely deliberative and publishing body. But it had to contend with many difficulties. While the greatest of these was the lack of funds in Kuomintang times, it had also in those days to compete with other almost parallel organizations, notably the National Peiping Academy, founded in 1929 largely by students who had returned from France. A re-organization was long overdue, and this has been effected thoroughly since 1949. The two former institutes of physics, for example, were amalgamated and have re-appeared with clearly differentiated spheres of work, so that one is now concerned with subjects such as nuclear physics and cosmic rays, whereas the other deals with the physics of solids and optical research. Formerly, there were in Shanghai and Peking five separate biological research institutes with overlapping and uncoordinated fields of work. These have now been re-organized into three different institutes, each with its own responsibilities.

The following is a list of the institutes:

Institute of Modern History, Peking.
Institute of Archæology (including Medieval History), Peking.
Institute of Linguistics and Philology, Peking.
Institute of Social Researches, Nanking.
Sub-Department of Social Researches, Peking.
Institute of Mathematics, Peking.

Institute of Modern Physics (nuclear, cosmic rays, etc.), Peking.
Institute of Applied Physics (solids, optics, etc.), Peking.
Institute of Physical Chemistry, Shanghai.
Institute of Organic Chemistry, Shanghai.
  Laboratory of Materia Medica, Shanghai.
Institute of Physiology and Biochemistry, Shanghai.
Institute of Experimental Biology, Shanghai.
  Laboratory of Developmental Physiology, Shanghai.
  Laboratory of Plant Physiology, Shanghai.
  Laboratory of Entomology, Peking.
Institute of Hydrobiology, Shanghai.
  Marine Biological Laboratory, Tsingtao.
  Taihu Limnological Laboratory, Wusih.
  Marine Biological Station, Amoy.
Institute of Systematic Botany, Peking.
  East China Botanical Station, Nanking.
  Lushan Botanical Station (Chiangsi), Lushan.
  Northwest China Botanical Station (Shensi), Wukung.
  Southwest China Botanical Station (Yunnan), Kunming.
Institute of Genetics and Plant Breeding, Peking.
Institute of Geology, Nanking.
  Laboratory of Pedology, Nanking.
Institute of Palæontology, Nanking.
  Laboratory of Cænozoic Research and Vertebrate Palæontology, Peking.
Institute of Geophysics and Meteorology, Nanking.
  Geophysical Experiment Station, Peking.
  Geophysical Experiment Station, Shanghai
Institute of Astronomy, Purple Mountain Observatory, Nanking.
  Astronomical Observatory, Hsu-Chia-Wei (Zikawei), Shanghai.
  Astronomical Observatory, Fêng-Huang-Shan, Kunming.
Institute of Ceramics and Metallurgy, Shanghai.
  Metallurgical Experiment Station, Kunming.
Institute of Metal Research, Peking.
Institute of Psychology, Peking.
Institute of Geography and Cartography, Nanking.
Bureau of Scientific Instruments (Preparatory), Peking.
Committee of Zoological Taxonomy, Peking.

Besides the research activities of the staff of the above institutes, the National Academy fulfils many other responsibilities. Its Bureau of Publications edits about ten scientific journals on behalf of the Academy itself, and a further twenty on behalf of the various societies, such as the Chinese Mathematical and Geographical Societies. The Library of the Academy has been re-organized, and a greater measure of centralization has been introduced; but separate departmental reference libraries in each institute continue, and last summer I was impressed by the amplitude of some of these, even in subsidiary laboratories. The translation of modern scientific terms into Chinese and the acceptance of standard equivalents has been an important problem for more than half a century. Before the end of the Ch'ing Dynasty, Yen Fu, the translator of Huxley and Spencer, was placed in charge of a 'Bureau of Terms', and this was expanded during the Kuomintang period as the 'Kuo Li Pien I Kuan', but its results did not meet the need. This work is now under the direction of the Academy, and is being rapidly pushed forward, with the consultative help of many hundreds of scientific workers from other organizations. A new development is the Bureau of Scientific Instruments, which makes apparatus needed for particular research projects, and is embarking on the production of high-precision instruments unobtainable on the market.

The leading technical body of the Academy is the Council, which is composed of twenty-six members. Its function is to handle the scientific aspect of all important problems. It consists of Ch'en Yin-Ko (history; formerly professor-designate of Chinese at Oxford), Chiang Li-Fu (mathematics), Y. C. Ma (economics), Wu Yu-Chang (philology), Hou Tê-Pang (chemistry), C. C. Chang (physiology), Ping Chi (zoology), Fan Wên-Lan (history), Chou P'ei-Yuan (theoretical mechanics), Ch'ien San-Ch'iang (Tsien San-Tsiang) (nuclear physics), C. C. Yang (palæontology), and so on. Contributory to it are the committees of specialists, corresponding roughly in number to the institutes mentioned above, but composed of scientific men drawn from universities and government departments as well as those who work in the National Academy itself.

The elaborate planning and re-organization in Academia Sinica has been paralleled by great changes in the universities. So far, this affects mainly Peking and Shanghai, where formerly there were many different universities, each with different origins and traditions. In Peking there were (besides smaller and less important ones) three great foundations: Peking University (*Pei Ta*), always a State institution; Yenching University, a missionary university; and Ch'ing-Hua University, based on the returned American Boxer Indemnity funds. It used to be said that the first of these corresponded in spirit to Oxford and the third to Cambridge; but in any event the spirit of separatism no longer corresponded with the urgent needs for social efficiency recognized to-day. In the formation of a single university analogous to the University of London, the humanistic subjects are being concentrated in Pei Ta, the applied sciences and engineering in Ch'ing-Hua Ta, and the pure sciences in Yenching (which will cease to exist as an independent university). So great is the emphasis upon geology and the importance of expanding the Geological Survey for the full use of China's mineral wealth that a new teaching institution for geology and mining will be created, based on the amalgamated geological departments of all the former universities.

Of course, the description of science in Academia Sinica and in the universities is only part of the story. Vast and elaborate research facilities have been set up under the Ministry of Health, a body which has the same governmental status as the National Academy. Apart from the National Institute of Medical Research, located mostly in Peking, there is the National Institute of Biological Products, an expansion of the former institutes which manufactured vaccines and sera. It now produces these on a far greater scale than formerly, but adds therapeutic hormone preparations and is beginning to make antibiotics on a mass scale. An immense production of modern insecticides is also carried out in the New China; but this is done mostly by firms in cities other than Peking. The production of vaccines by the National Institute of Biological Products and its seven subsidiary factories is still under the direction of that admirable bacteriologist T'ang Fei-Fên, to whose work I referred in *Nature* in 1943. Among its more interesting new developments is the production of a vaccine for Chinese summer–autumn encephalitis using mouse brains.

So far, there has been little or no realization in Europe of the extraordinary progress in public health which the Government has been able to achieve. In the cities and villages there has been a universal campaign against flies, mosquitoes, and other noxious insects, so that Peking, for example, has become freer from flies than most European cities. Thirty-five million rats were killed in north-east China in 1951, and another ten million in the first months of 1952. Formerly, vaccination was infrequent, the largest number of persons vaccinated in any one year being 7·3 million (1946); but since 1949, 307 million (more than half the total population) have been

vaccinated. Infantile and maternal mortality have been reduced by a half since 1949. A very interesting development has been the mobilization of the old-fashioned practitioners who follow the traditional system of Chinese medicine; they have been instructed sufficiently in modern medicine to enable them to play a valuable part as inoculators, dressers and givers of first-aid who can deal with minor complaints. Midwives have also been systematically re-educated. The health-education movement, in which all possible methods of publicity are employed, and in which every member of the community participates, is almost unprecedented in history, and constitutes the active execution of measures formerly vainly urged by successive international health organizations. It reaches into the remotest corners of the country.

Naturally, all this costs money, but it is not spared. For scientific research institutes as a whole, the budget for 1952 was ten times that of any year in the Kuomintang period, and for 1953 the four-fold expansion planned will bring it to no less than forty times. Thinking of former conditions, I asked last summer when visiting the Laboratory of Entomology of the Academy how many research workers there were, perhaps a dozen or so; and received the reply that they had more than fifty, though quite a number were away on field expeditions.

The effectiveness of collaborative scientific work is also much greater than before. Dr. Li Ssu-Kuang told me that whereas, under the Kuomintang, meetings of scientists could scarcely ever do more than pass resolutions which were never executed, the atmosphere in the New China is much more practical. For example, at the beginning of 1950 a conference of geologists in Peking took decisions concerning field-work for a number of units, and, before six weeks were out, more than eighty geologists were on the way to the north-east, the north-west and central China, to study the structural geology of the areas and to search for iron, coal, oil and non-ferrous metals. The greatest importance is attached to the geological sciences as vital for the development of China, and in August 1952 the Geological Survey was raised to the status and title of a Ministry, with Li Ssu-Kuang (J. S. Lee) as minister. There can be no other nation where the sciences of the earth are so highly regarded.

The close union between science and the people in New China is a fact which must impress every Western visitor who spends some months in the country. Perhaps by the very fact that the standard of their life was formerly so low, they look to science and technology as one of the great forces able to lead them into a state of freedom from poverty, disease and want. Chinese scientific workers are now inspired by this faith and trust. Moreover, they are given the means to respond to it. Dr. Li himself has written: "In the situation which has arisen with the victory of the Chinese people's revolution, it will readily be understood that science is no longer looked upon as an esoteric activity reserved for a leisure class, but as a public enterprise to be shared by all people, who instead of being reticent as formerly, now conscious of what they need, raise their voices in positive demands in every walk of life. It can now be said that in every sphere, the people will accept nothing that is mechanically imposed on them. They are determined to make their own choice in matters of policy, a choice which demands knowledge and the scientific outlook".

OBITUARIES

Sir Charles Arden-Close, K.B.E., C.B., C.M.G., F.R.S.

Sir Charles Frederick Arden-Close, who died at Winchester on December 19, was born in Jersey on August 10, 1865. He was the eldest son of Major-General Frederick Close, of Shanklin, Isle of Wight, and took the name of Arden-Close in 1938, in compliance with the terms of a bequest.

Commissioned in the Royal Engineers on July 5, 1884, Close served first at Gibraltar, and later with the R.E. Balloon Detachment. In 1888 he was ordered to India, and, next year, joined the Survey of India, gaining in that service a varied experience of practical surveying which he put to good use in later years.

In 1893 Close returned to England, and, two years later, was placed in charge of the survey of the Nigeria–Kamerun boundary. After this he joined the Ordnance Survey in Great Britain, and in 1898 was appointed British Commissioner on the Tanganyika–Nyasaland Boundary Commission. Having completed this work, he returned to the Ordnance Survey, and, in 1900, was ordered to South Africa in charge of a small R.E. survey detachment. He contracted enteric fever, however, and soon had to return to England, rejoining the Ordnance Survey as soon as his health had been restored.

In 1902 Close was appointed instructor in surveying at the School of Military Engineering, Chatham, and, while there, prepared his well-known "Text-Book of Topographical Surveying", which quickly became, and has remained ever since, the standard work on the subject throughout the British Commonwealth.

In 1905, he became chief of the Geographical Section of the General Staff at the War Office, and in that capacity played a prominent part in securing the establishment of the Colonial Survey Committee, and in drawing up the working rules for the production of the Carte Internationale du Monde au Millionième at the London Conference of 1909.

In 1911 Close was appointed director-general of the Ordnance Survey, holding this appointment throughout the First World War. Naturally, the War interfered with the civil work of the Survey, but the department sent a detachment to France in 1918, and printed enormous numbers of maps for the armies in France and elsewhere.

Sir Charles retired in 1922, but continued to devote himself to geographical work and study. He became president of many geographical organizations, and, with his wide knowledge and dignified yet genial personality, filled these offices with unusual distinction and success. He was president of the International Union of Geography during 1934–38, president of the Royal Geographical Society during 1927–30, president of the Geographical Association in 1927, and also, for many years, chairman of the Palestine Exploration Fund.

Sir Charles married, in 1913, a daughter of Mr. Thomas Percival, of Shanklin, and had two sons and a daughter. He was the recipient of many honours and distinctions. He was made a C.M.G. in 1898, a C.B. in 1916, a K.B.E. in 1918, F.R.S. in 1919, and he received an honorary Sc.D., Cambridge, in 1928. In 1914 he gave the Halley Lecture at Oxford, and, in 1927, was awarded the Victoria Medal of the Royal Geographical Society.

M. N. MacLeod

Dr. J. T. Edwards

Dr. J. T. Edwards, who died on November 7, made noteworthy contributions to veterinary science. He had a brilliant scholastic career, and when he qualified in 1911 was undoubtedly regarded by many of his seniors as the best veterinary graduate of his generation.

After study at the Pasteur Institute, Paris, under a three-years research scholarship, study in Germany having been prevented by the First World War, he served for two years in France with the Army Veterinary Corps, and was mentioned in dispatches. Some years of research under the late Sir John M'Fadyean followed, and he was then appointed to the new chair of veterinary hygiene at the Royal Veterinary College, London, in 1920. He received the degree of D.Sc.(London) in 1926, the title of his thesis being "The Chemotherapy of Surra in Horses and Cattle in India".

In 1921, Edwards was appointed director of the Imperial Bacteriological Laboratory (later Imperial Institute of Veterinary Research), Muktesar, India, the most important veterinary appointment in that country, and for the next eight years produced work of remarkable value, carrying out intensive investigations on a wide range of animal disease subjects.

His research work on rinderpest proved to be of a very high order, although its full value was not universally recognized until after an interval of nearly twenty years. The results of this investigation were not published in detail at the time because of preoccupation with current work.

Rinderpest immunization had tended to be hazardous, partly because of the danger of intercurrent infection with piroplasmosis and certain other diseases precipitated by the body reaction to the vaccine, and partly because of varying susceptibility of cattle to the virus. Edwards conceived the idea of adapting the virus to rabbits as unnatural hosts on the basis of the work of Jenner and of Pasteur, in the hope of obtaining a living virus which would immunize without producing the disease, and he laboriously set out on what appeared to be a hopeless task. He achieved success, but not final success. At the peak of the work his rabbit stock was wiped out by bacterial infection. In India there was no stock of rabbits to replace them and he turned his attention to the goat, again in the hope of producing a suitably modified virus. He succeeded, and his goat-adapted strain of the rinderpest virus has proved to be a highly efficient live vaccine for the immunization of Indian cattle, and it has been used systematically in India ever since with great success. After suitable modification for cattle in Africa, it has proved of great value also in that continent.

Japanese workers produced a rabbit-adapted rinderpest virus in the nineteen-thirties and acknowledged the inspiration of Edwards's work. Their rabbit strain has since proved to be immensely valuable. So Edwards's work on the rabbit-adapted and the goat-adapted strains of the rinderpest virus has stood the test of time and provided outstanding developments in all work on this terrible disease of cattle. Now, for the first time, and entirely as a result of these developments, leaders at international conferences are speaking hopefully of the eradication of rinderpest from continents.

There has been a further development of this work. In the United States in recent years the swine-fever virus has similarly been adapted to rabbits, and the modified strain has been used with great success for the immunization of pigs. American workers have acknowledged the lead provided in this work by the results Edwards achieved with the rinderpest virus. At the present time this new swine-fever vaccine is regarded as the most important advance made in the study of that disease, and great advantages are anticipated from its use.

In 1929 Edwards returned to England and joined the staff of the Foot and Mouth Disease Research Committee, working first at the Lister Institute and later at the Pirbright laboratory.

Edwards published many papers on a variety of subjects, and a number of his contributions will maintain their importance for years to come. He was active over a wide range of veterinary activities in Britain during the past two decades and was very highly respected in his profession.

He was awarded honours by his profession, and when on deputation to the Egyptian Government was awarded the Order of the Nile (3rd Class) by the late King of Egypt. He was a past president of the Section of Comparative Medicine of the Royal Society of Medicine. He was a member of the Councils of both the Royal College of Veterinary Surgeons and of the British Veterinary Association.

During 1916–21 he edited the *Tropical Veterinary Bulletin*, and, after the death of Sir John M'Fadyean, he became one of the editorial board formed to continue the *Journal of Comparative Pathology and Therapeutics*.

Edwards was deeply interested in psychology and in animal behaviour. In recent years he devoted much of his literary activities to veterinary history, on which he published important contributions in the *Veterinary Record* and elsewhere.

W. A. Pool

Prof. Johan Böhm

The newly organized Czechoslovak Academy of Science and the Research Institute of Organic Syntheses have suffered a great loss by the decease of the distinguished physical chemist, Prof. J. Böhm, on November 27, 1952. Born in 1895 in Budějovice, Southern Bohemia, Böhm studied at the German Institute of Technology and at the University of Prague, and also worked in the Kaiser Wilhelm Institut für physikalische Chemie, Berlin. At that time this Institution was at its height under the leadership of Prof. F. Haber, with collaborators such as v. Hevesy, Willstätter, Zsigmondi, Freundlich and Polányi. Böhm graduated at the period of the successful start of X-ray applications to structural analysis of crystals and himself added much to the perfection of this method. His first work elucidated the binding of water in zeoliths, and later research solved the structures of several metallic hydroxides, especially of γ-AlO.OH, which modification has been called 'böhmite' in his honour. This was in 1926, in which Böhm also investigated the strongly exothermic spontaneous recrystallization of finely powdered silver and antimony. At the same time, Böhm constructed with Weissenberger the well-known X-ray goniometer.

Soon after that, Böhm went with v. Hevesy to Niels Bohr's laboratory; but when v. Hevesy was invited by the University of Freiburg-im-Breisgau to fit up the Institute of Physical Chemistry he took Böhm with him. Böhm remained in Freiburg until 1934, first building and installing X-ray laboratories,

introducing there his new 'secondary' method of structural X-ray analysis, and, as research director in physical chemistry, practical classes in photochemistry and colloids. He became assistant professor in 1934.

However, the Nazi era altered Böhm's scientific life. Profs. v. Hevesy and Böhm had to leave Germany. The latter, who always kept his Czechoslovak nationality, accepted the invitation of the Czechoslovak government to the chair of physical chemistry at the German University in Prague. During the German occupation of Prague, Böhm was again subjected to political pressure; but he never joined the Nazi party, and continued to help his numerous Czech friends in their scientific work in a fearless manner.

Böhm's own research work in the war years concerned again X-ray investigations and photography; but it remains mostly unpublished, as his pupils left Prague in the critical year 1945. When conditions settled down again, Böhm was employed as a research chemist in the national enterprise Rybitví near Prague, and remained there in spite of several offers of a post as a university teacher. The many sufferings he had sustained had deprived him of self-confidence. At last he consented to work in the physico-chemical laboratory of the Czechoslovak Academy of Science and was one of the first of the nominated corresponding members of that institution.

Prof. Böhm possessed not only a great capacity for experimental work, but also a unique strength of character. His philosophical attitude and faith in social justice guided him safely through national and political struggles. His great modesty, self-denial and willingness to help others led to over-work, which destroyed the hopes of his friends just when he had returned to academic research.

J. Heyrovský

Prof. Otto Pratje

Prof. Otto Pratje, who was both head of the marine geological section of the German Hydrographic Institute and lecturer in geology at the University of Hamburg, died on December 11, at the age of sixty-two.

Although originally committed to a commercial career, Pratje studied geology concurrently for several years in Britain and Sweden. After the First World War, he decided that his profession was not to his taste, and took his doctor's degree at Freiburg in 1921 under Deecke. During the ensuing period he worked as an assistant at the University of Freiburg on the marine sediments of the Continent of Europe.

The course of his life's work was, however, decided by his move to Königsberg, where he acted as a university assistant and lecturer during 1923–27. His chief study was the geology of the sea-bed, and it was to this that he owed his participation in the *Meteor* Atlantic expedition during 1925–26. In 1937 he was appointed to establish and direct the marine geological section of the Deutsche Seewarte at Hamburg. After the Second World War he joined its successor, the German Hydrographic Institute, and also became a member of the lecturing staff of the University of Hamburg.

The abundance of Prof. Pratje's publications bears witness to his diligence and fertile mind, and will be a lasting monument to him. While his earlier papers were devoted to the geological and palæontological problems of the Continent, in particular those of the Jurassic formations of south-west Germany, marine geology came more and more into the foreground during the Königsberg period. At first he wrote several papers on Heligoland, including the well-known geological guide, but then turned completely to the sea-bed. He also made a systematic collection of bottom samples during many research voyages. In addition to a number of papers on the formation of sediments in the North Sea and the Baltic, we owe to him what are believed to be the most detailed geological charts of these seas yet compiled. Parallel with this work, Pratje carried out the laborious evaluation of the bottom samples collected during the *Meteor* expedition, of which two parts have appeared in print. Unfortunately, his official duties, combined with war-time and post-war conditions, prevented the completion of this work. Finally, in an extensive paper in the "Handbuch der Naturwissenschaften", he described the techniques and methods of collecting and evaluating samples from the ocean bottom, supplementing it, in the "Jahrbuch der Geographischen Gesellschaft", with references to his most recent experience.

Prof. Pratje laboured much and achieved much, though some of his work was incomplete when he died. What remains is the memory of a kindly man who was always ready to collaborate, in whose presence no harsh word was ever heard, and who knew how to suffer hard blows with a quiet mind.

Prof. Francesco Vercelli

We regret to report that the distinguished Italian geophysicist, Prof. F. Vercelli, director of the Geophysical Observatory and of the Thalassographical Institute of Trieste, died, at the age of sixty-nine, on November 24.

Prof. Vercelli contributed to research in several branches of geophysics. In oceanography he investigated the transmission of solar radiation through sea and lake water and the effects of wind and pressure variations on the tides, and led oceanographic expeditions in Italian naval vessels to various parts of the Mediterranean and Red Sea. He devised a method of harmonic analysis and applied it to the prediction of pressure changes. He sought for the sunspot cycle in tree-ring records. His earliest geophysical work was concerned with temperature in tunnels in connexion with the construction of the Simplon tunnel; later, he founded a seismological station at Trieste and took part in seismic and electromagnetic prospecting for oil in the Po valley.

He was appointed director of the Geophysical Institute of Trieste in 1920. When the Institute was divided in 1949, he became director of both the Geophysical Observatory and the Thalassographical Institute. His last years were devoted to preparing a second edition of his book on meteorology, "L'Aria", and to writing a large work on oceanography, "Il Mare".

We regret to announce the following deaths:

Prof. G. D. Hale Carpenter, M.B.E., Hope professor of zoology in the University of Oxford during 1933–48, on January 30, aged seventy.

Prof. J. H. Orton, F.R.S., emeritus professor of zoology, University of Liverpool, and formerly director of the Marine Biological Station, Port Erin, on February 2, aged sixty-eight.

NEWS and VIEWS

Prof. P. M. S. Blackett, F.R.S.

On his appointment to the chair of physics at the Imperial College of Science and Technology, London, in succession to Sir George Thomson, Prof. P. M. S. Blackett resigns at the end of the present session from the Langworthy chair of physics in the University of Manchester which he has held since 1937. In the two years before the War, Prof. Blackett created a large and important school of cosmic-ray research in Manchester. Largely through his inspiration at this time, a chair of theoretical physics came into existence—occupied first by Prof. D. R. Hartree and later by Prof. L. Rosenfeld. But perhaps Blackett's most significant achievements belong to the post-war period. As a member of the Barlow Committee he was prominent in securing the expansion of the universities of Great Britain, and with his own department he set a brilliant example in the use of the new opportunities thus provided. An honours school numbering little more than a dozen was immediately increased six-fold, and this expansion in teaching was accompanied by spectacular developments in research, in which Blackett's wide interests and sound judgment were everywhere apparent. After the discovery of the *V*-particles by Rochester and Butler in 1947, the work was extended to the Jungfraujoch and Pic du Midi; while in Manchester, J. G. Wilson's magnetic cosmic-ray spectrograph was constructed and considerable developments took place in all aspects of cosmic-ray research. At the same time the Jodrell Bank Experimental Station was being developed for work in radio astronomy, and Blackett was working on his theory of the magnetic field. Experimental work on the latter provided Blackett with a new outlet for his individual experimental skill, in which he developed magnetometers of very great sensitivity. The width of his interests and activities was again emphasized in 1951 when chairs of theoretical astronomy and of radio astronomy were established in his department.

Blackett exercised a great influence on the post-war developments in the University of Manchester and in administrative affairs. He was dean of the Faculty of Science during 1948–50; a member of Council during 1949–52 and pro-vice-chancellor during 1950–52. He is a member of the National Research Development Corporation and has served on many atomic energy and defence committees. The award of the Nobel Prize in 1948 gave great pleasure to Blackett's many friends throughout the world, who will join in wishing him continued success in his new post. Manchester regrets the loss of one of the world's most distinguished scientists, who enhanced in a brilliant manner a remarkable heritage of Langworthy professors.

Prof. Willis Jackson

Prof. Willis Jackson has been appointed director of research and development at Metropolitan-Vickers Electrical Co., Ltd., as from July 1 next, in succession to Dr. C. Dannatt, who took over from Sir Arthur Fleming in 1951 (see *Nature*, 168, 587; 1951). Prof. Willis Jackson is professor of electrical engineering in the University of London at the Imperial College of Science and Technology, having succeeded the late Prof. Cecil L. Fortescue in 1946. His career has been closely associated with Manchester, for after graduating from that University he became a college apprentice in the firm to which he is now returning, and later joined the research staff of the organization. He relinquished this position in 1938 on his appointment to the chair of electro-technics at Manchester.

Prof. Jackson's work at the Imperial College has been characterized by the energy and enthusiasm which those who know him expect as a matter of course, and both as head of the Department of Electrical Engineering and, during the past two years, as dean of the City and Guilds College, he has won the respect and affection of his colleagues for the efficient and cheerful way in which he has carried out his many duties. His energies have, however, not been confined to academic matters; among many extra-mural interests he has served on the Council of the Institution of Electrical Engineers and its Education Committee for nine or ten years, has been a member of the Technology Sub-Committee of the University Grants Committee and a member of the Scientific Advisory Council of the Ministry of Supply since 1948, and has taken an active part in the work of many other important bodies concerned with professional education and research. In spite of these varied demands he has found time for personal research, his main interests being in the properties of electrical insulating materials and in micro-wave measurements. Prof. Jackson's wide experience in both education and research augurs well for his success in the responsible position which he is to assume, and the high standards set by his predecessor, Sir Arthur Fleming, whose work at 'Metro-Vick' has won the admiration and respect of the whole engineering profession, will be in safe keeping.

Higher Technological Education in Britain

In a written answer in the House of Commons on January 29, to questions as to whether the Chancellor of the Exchequer could now give details of plans for the establishment of a technological university or university college of technology in Britain, Mr. J. A. Boyd-Carpenter, Financial Secretary to the Treasury, stated that after consulting the University Grants Committee, the Government proposes to place further resources at the disposal of the University of London to facilitate the expansion of the Imperial College of Science and Technology. The aim would be to raise the number of full-time students from the present 1,650 to 3,000 during the academic quinquennium 1957–62. So that the work of the Imperial College could be co-ordinated with that of other schools of the University, and full advantage taken of the whole of the University's resources, as well as to minimize disturbance of current work of the College, the expansion would take place around the existing site of the College in South Kensington. The College had been invited to submit plans based on the assumption that the College would have first claim on other parts of the area between Prince Consort Road and Imperial Institute Road as it became possible to release them from their present uses. The phasing of the plans would, of course, require careful consideration in consultation with other interests affected.

This development is clearly in pursuance of the policy already announced by the Government of building up at least one institution of university rank devoted predominantly to the teaching and study of higher technology. In addition, the Government proposes to make resources available for further developments in other parts of Great Britain, and the University Grants Committee has been asked to

advise the Chancellor of the Exchequer where such further resources might be deployed. These projects are to be additional to the developments of higher technological education already in progress.

International Council of Scientific Unions : Report for 1951

THE report of the executive committee of the International Council of Scientific Unions for 1951, edited by Prof. F. J. M. Stratton (pp. 108 ; from the Secretariat, Gonville and Caius College, Cambridge ; 1952), includes the text of the revised agreement between the Council and the United Nations Educational, Scientific and Cultural Organization (Unesco) which brings the agreement into line with those made between Unesco and other organizations. The Council has also been granted consultative status by the Economic and Social Council of the United Nations. Rules for Joint Commissions of the Council have been approved by the executive board and are also appended, and under the new rules the future status of five Joint Commissions, which have been in existence for more than three years, was discussed. The Joint Commission for Rheology was renewed for one year on the understanding that it would become a section of the International Union for Theoretical and Applied Mechanics, and the Joint Commissions for the Ionosphere, for Solar and Terrestrial Relationships, for Radiometeorology and for Oceanography were renewed for three years, but the terms of reference of the last-named were restricted to "the investigation of the deep-sea floor". The title of the Joint Commission for Radioactive Standards, Units and Constants has been changed to Joint Commission on Radioactivity. A proposal to form a new Joint Commission on Electronomic Microscopy was approved. The Joint Committee on Physics Abstracting was dissolved at its own request, and the formation of an International Service of Science Abstracting was approved ; the new International Abstracting Board—the agreed title for the service—will not accept fresh subjects, however, until the experimental stage with the Committee on Physics Abstracting is complete and the Board well established in that field. Decisions on the admission of the International Unions of Biochemistry and of Scientific Psychology were deferred. In spite of the steady position of the financial balance in the accounts, printing costs give rise to anxiety. Appended to the report of the Executive Committee are the customary reports from the International Unions and the various Joint Commissions. These include a first report from the Joint Commission on High Altitude Research Stations, which held its first meeting at Bagnères-de-Bigorre during August 23–26, 1950, a meeting which appears to have considerably stimulated, *inter alia*, high-altitude research in South America as an international activity.

Short Circuits set up by Kestrels

MR. H. LLOYD, of the Yorkshire Electricity Board, writes : "66,000 volts transmission lines in the Yorkshire and North Lincolnshire areas had been subject to a number of mysterious faults, which nearly always occurred about dawn, for several years before the trouble was found to be caused by kestrels which were escaping alive. The points of interest in pursuing the investigation into this were, first, how it was that the birds were surviving 38,000 volts applied across their bodies, and second, what was attracting them to the lines ? The incidents always occurred in the early morning or in the misty weather when the birds' plumage could be assumed to be damp. The flashover is initiated across the damp wings when the bird is banking steeply with its back to the insulators, and current does not pass through the bird's body. The speed at which the bird is travelling takes it out of the path of the arc before it becomes too severely burnt. Other birds subject to high voltages are normally completely carbonized. It was at first thought that a few enterprising birds had discovered that it was possible to survey the surrounding ground less obtrusively and with less effort when static from a 45-ft. high perch. Gamekeepers and others thought this improbable, and the theory did not agree with the damage to the birds. There was no evidence that small birds were using the somewhat exposed cross-arms as perches, and we were informed again that kestrels generally preferred ground game. One day, a substation attendant, during misty weather, noticed a kestrel circling a string of insulators in ever-narrowing circles and, had the bird not been scared off, it would probably have run into trouble. The insulators, as is usual under humid conditions, were discharging and emitting an intermittent buzzing noise, and this seems to provide the attraction. In a very recent case the weather was foggy and visibility limited to a few yards. This seems to imply that kestrels hunt by ear as well as sight, and it occurred to me that this might be of interest to ornithologists and others. Bird lovers will be glad to know that, with later forms of construction, two kestrels will have to execute a very complex movement before they get into trouble".

This interesting observation is most likely explained by the possibility of kestrels hunting by ear as well as by sight. Miss Frances Pitt writes : "The kestrel certainly has good hearing. A tame one I had came from a considerable distance when called in a quite low voice. But the bird's method of hunting suggests that it depends on its eyes to find prey".

Science and Film

A RECENT issue of *Science and Film* is largely taken up with the activities which went on at the International Scientific Film Association's sixth yearly congress in Paris during September 1952 (1, No. 4 ; December 1952). Among the films which were presented at the congress was one, "Introducing the New Worker", which deals with the problem of works relations and factory psychology. A remarkable film was one from Eastern Germany called "Arbeit aus neuem Geist", dealing with methods of raising production-levels by means of the analysis of work done and by creating a profitable emulation or 'activism' in each team of workers. The high-speed camera was used in France for making a valuable research film on argon arc-welding, while another research film from France was the "Study of Flames", made for the Institut de la Recherche dans la Sidérurgie. Among industrial training and instructional films presented at the congress were the British films, "Basic Principles of Lubrication", "Submarine Control" and "Hardening and Tempering Carbon Steel". From Czechoslovakia came the "Polarograph" and "Electro-erosive Machining", while France supplied "Les Miroirs Plans", a teaching film on plane mirrors. Among the more outstanding documentary films were "Le Cuivre", describing the process of copper-mining in the Belgian Congo ; "Charge de Rupture", describing the work of the

Laboratory for Research into Reinforced Concrete Techniques at the University of Ghent; and "Volga-Don Canal", the preliminary to a major Soviet film in colour on the same subject which is shortly to be made available for public distribution. The journal also describes various technical demonstrations at the congress, the use of sound film loops in industrial training, stereoscopic cinematography and a new device for automatic photometry.

Experimental Elimination of Chromatophores and Eyespot in *Euglena*

E. G. and O. Pringsheim (*New Phytol.*, 51, No. 1, 65; 1952) have reported a very interesting case of the permanent elimination of plastids and eyespot in *Euglena gracilis* by exposure to high temperature and also by treatment with streptomycin. When *E. gracilis* was grown for 5–6 days at 34–35° C.—just below the maximum for multiplication—the chromatophores of most strains were caused to disintegrate and permanently apoplastidic strains were obtained. In a few of the strains the eyespot also disappeared permanently. Considerable differences in response to the treatment were observed in different strains, the effect of streptomycin, strain for strain, yielding parallel results. Both the chromatophores and eyespots are independent, self-reproducing cell components, and once destroyed do not reappear. The artificially produced strains apparently retain their heterotrophic nutrition and vigour indefinitely. The differences in the response of different strains of the organism to the experimental treatments are due to inherent, that is, genetical, factors.

Integration of Scientific Thought

Some years ago, the inherent dangers of specialist knowledge—when carried to extremes—were foreseen, and its impact upon Western culture in general led to the formation of the Institute for the Unity of Science as an outgrowth of the American Academy of Arts and Sciences. Prof. P. Frank, in some interesting remarks to a meeting of the Institute, reported in a recent publication entitled "Contributions to the Analysis and Synthesis of Knowledge" (*Proc. Amer. Acad. Arts Sci.*, 80, Part 1; 1951; pp. 112, 2 dollars), pleads for the reinstatement of philosophy as a link between the arts and sciences, while President J. B. Conant (Harvard University) stresses the dynamic nature of science. A threefold scheme is then developed by some of the leading methodologists and semanticists of the United States, namely: science and man; the 'meaning' of scientific statements; and the role of 'abstract objects' in science. As a collection, the contributions are stimulating, and calculated to advance the integration of a wide field of studies.

British Astronomical Association: Annual General Meeting

At the annual general meeting of the British Astronomical Association, held in Burlington House, London, on October 29, the retiring president, Dr. G. Merton, delivered an address in which he dealt first of all with the internal affairs of the Association. It is very satisfactory to know that the membership, which was 856 in 1942, is now well over two thousand and is still increasing, and also that the observing sections continue to flourish with increasing membership as well as with increasing activity when observing conditions are favourable. Dr. Merton took as his main subject, "Photography and the Amateur Astronomer", in which he gave a historical sketch of the developments in photography, referring to a number of astronomers who had carried out very useful work in this branch. The address was illustrated by a series of lantern slides, and, in concluding it, he pointed out a number of ways in which amateur astronomers could make use of photography. In particular, Dr. Merton referred to the scheme of the new director of the Aurora and Zodiacal Light Section for obtaining co-operative work in parallactic photography with fast cameras. During the evening the Walter Goodacre Medal and Gift were presented to Mr. Frank Maurice Holborn. Dr. Merton gave a short account of Mr. Holborn's work in astronomy in different branches, but more especially on variable stars, and paid a high tribute to his devotion to the work of the Variable Star Section, as well as to his contributions to other sections. The new president of the Association, Mr. E. H. Collinson, who took over from Dr. Merton, is well known for his contributions to astronomy in various branches, especially for his papers on meteors, and his photography of them, a branch on which he has worked for many years.

Bibliography of Differential Thermal Analysis

Any material which undergoes a phase change when heated can be studied by the method of differential thermal analysis, and this method is widely used by geologists, investigators in the fields of ceramics and agriculture, and by chemists, metallurgists and fuel technologists. At the Institute of Science and Technology of the University of Arkansas, Fayetteville, Prof. W. J. Smothers, Y. Chiang and A. Wilson have compiled a "Bibliography of Differential Thermal Analysis" (Research Series No. 24; pp. 44; 1951) which lists 165 papers published between 1887 and 1950 inclusive, and facilitates the identification of relatively unknown substances that are often present in materials subjected to thermal analysis. The bibliography consists of four parts. The first presents a brief description and history of the method; then follows the chronologically arranged list of technical papers; the third is an author index, and the last part is an index of materials analysed by the differential thermal method. The physicist will probably find the short section dealing with equipment of most interest. The best type of thermocouple and its position in the sample, the heating-rate, furnaces with uniform heating-rate and the replacement of photographic by electronic recording, are briefly discussed. As an initial, and quick, reference work, this pamphlet should prove useful.

Royal Sanitary Institute: Annual Health Congress

The annual Health Congress of the Royal Sanitary Institute will be held in Hastings during April 28–May 1, under the presidency of Lord Eustace Percy. The Congress will be divided into eight sections (*A*–*H*) and four conferences (1–4) as follows: sections (*A*) preventive medicine, (*B*) engineering and architecture, (*C*) maternal and child health, (*D*) veterinary hygiene, (*E*) food and nutrition (in conjunction with the Food Group, Society of Chemical Industry), (*F*) housing and town planning, (*G*) tropical hygiene, and (*H*) occupational health; conferences (1) medical officers of health, (2) engineers and surveyors, (3) sanitary inspectors, and (4) health visitors. It is anticipated that about two thousand five hundred persons will attend the Congress, including repre-

sentatives of local authorities, government departments, public bodies, universities and learned societies in Great Britain and elsewhere. Further details can be obtained from the Institute at 90 Buckingham Palace Road, London, S.W.1.

Thirteenth International Congress of Pure and Applied Chemistry

THE Thirteenth International Congress of Pure and Applied Chemistry will be held in Stockholm during July 29–August 4, 1953, and in Uppsala during August 5–7, 1953. At the same time the Seventeenth Conference of the International Union of Pure and Applied Chemistry will take place. The Congress will comprise a Physical Chemistry Section with the following groups: chemical thermodynamics and thermochemistry, electrochemistry, surface chemistry, colloid chemistry, macromolecular chemistry, chemical kinetics, reactions of free radicals, and other fields of physical chemistry. There will also be a symposium on the chemistry of wood and wood constituents, which will be divided into three sections: structural chemistry of wood constituents, chemistry of cellulose and hemicellulose, and the chemistry of lignin. Immediately after the Congress a symposium on macromolecules will be held in Uppsala. Application forms for attendance at the Congress (to be completed by March 1) and further information can be obtained from the general secretary, Dr. Bengt Sandberg, Thirteenth International Congress of Pure and Applied Chemistry, Stockholm 70.

First World Congress on Fertility and Sterility, New York

THE First World Congress on Fertility and Sterility will be held during May 25–31 at the Henry Hudson Hotel, New York City, under the sponsorship of the International Fertility Association with the co-operation of the American Society for the Study of Sterility. About eighteen hundred scientific workers from fifty-one countries are expected to attend. Twenty-three scientific sessions will be held, which will embrace the entire field of fertility and sterility, including sessions dealing with socio-economic factors, psychosomatic aspects and artificial insemination. The sessions will be conducted in English, French and Spanish, with the use of earphones and simultaneous translations, as in the United Nations meetings. In addition to the scientific sessions there will be medical round-table discussions, question-and-answer periods, scientific exhibits and films. Those who wish to attend should register as soon as possible with the Chairman of the Local Arrangements Committee, 1160 Fifth Avenue, New York 29, N.Y.

Third International Conference on Soil Mechanics and Foundation Engineering

THE Third International Conference on Soil Mechanics and Foundation Engineering will be held in Switzerland during August 16–27. The first part of the Conference will take place in the Kongresshaus, Zurich, during August 16–21, when the programme will consist of the main bulk of the lectures and discussions with receptions, excursions, visits to laboratories, and a banquet and ball. During August 22–25 there will be a four-day tour through Switzerland, when the opportunity will be given of seeing not only points of interest for geotechnical and foundation engineering but also something of the country's natural beauty. The final session will be held in Lausanne on August 26, after which an excursion will be made to the dams of Grande Dixence and Mauvoisin, which are under construction. The official languages of the Conference will be English and French. Reservations for hotels at Zurich and Lausanne and for the excursions should be made not later than June 15, preferably as soon as possible. All inquiries should be addressed to the general secretary of the Conference, Dr. A. von Moos, Gloriastrasse 39, Zurich 6.

Developments in Microscopical Methods

THE Royal Microscopical Society (Industrial Section), in co-operation with the Optical Group of the Physical Society, the Physical Methods Group of the Society of Public Analysts and Other Analytical Chemists, and the Industrial Spectroscopy Group of the Institute of Physics, is organizing a meeting under the above title, to be held at King's College, London, on March 20. The first session of the meeting, at 2.30 p.m., will be a lecture demonstration, "The Use of the Polarizing Microscope in Organic Chemical Research". The second session, beginning at 4.30 p.m., will consist of a number of short papers, the general theme of which will be "Useful Attachments to the Microscope and Analytical Methods"; a number of exhibits and demonstrations illustrating the same theme will be on view in adjacent laboratories. In the third session, at 6.15 p.m., there will be a lecture demonstration on "Cinemicrography". Full details of the meeting, with synopses of the papers and short descriptions of the exhibits, are given in the programme, which can be obtained (price 1*s*.) from the Assistant Secretary, Royal Microscopical Society, Tavistock House South, Tavistock Square, London, W.C.1.

Guido Fubini Prize in Mathematics

AN international prize in mathematics, in memory of the late Guido Fubini, has been founded by his friends and admirers and will be administered by the Unione Matematica Italiana. The prize will consist of Italian currency equivalent to about 550 gm. of gold and will be awarded for important contributions in the field of differential geometry published between January 1, 1946, and December 31, 1953. Applicants are invited to submit their work to the Unione Matematica Italiana (address: presso Istituto Matematico 'Pincherle', Universi à di Bologna) before March 31, 1954; but the awarding committee may also consider publications for which no such application is made. If there should be no suitable work in differential geometry, the committee can award the prize for contributions made in the same period to the theory of automorphic functions and related topics.

University of Birmingham

THE following appointments have recently been made in the University of Birmingham. To be lecturers: Dr. W. O. Lock (physics), T. Broom (industrial metallurgy), Dr. G. F. Eveson (mining), and Dr. R. C. Porter (chemical engineering). To be Imperial Chemical Industries, Ltd., Research Fellows: Dr. A. J. Nutten (chemistry) and Dr. G. K. Williamson (metallurgy). J. T. Edward, Imperial Chemical Industries, Ltd., Research Fellow in the Department of Chemistry, has resigned. The title of University Research Fellow has been conferred on K. H. Stark during the tenure of his post in the Department of

Electrical Engineering. The degree of D.Sc. of the University has been conferred on F. R. N. Nabarro (metallurgy) and F. J. Richards (botany).

Nuffield Foundation Awards in Dentistry, Biology and the Social Sciences

The Nuffield Foundation is offering a number of fellowships, scholarships and bursaries in the fields of dentistry, biology and the social sciences as follows. The fellowships for dentistry are for persons, aged 25–35 years, with dental qualifications, to receive additional training in pure and applied science so as to undertake an academic career in dentistry, and also to enable graduates in medicine or science to receive training (not necessarily for a registrable dental qualification) that will fit them for teaching and research in dental health and disease; the fellowships are worth £500–800 a year for one to three years, and applications must be received by March 1. Dental scholarships, normally for one year only, are available for students at university dental schools in the United Kingdom and cover tuition fees and a subsistence allowance of not more than £200; applications must be received by June 30. The Foundation's scholarships and bursaries in biology and the social sciences are for graduates of British universities, preferably within the age-group of 22–35 years. The awards in biology are for persons who have graduated in physics, chemistry or mathematics but who have had no training in a biological subject, and who wish to receive such training in biology as will enable them to undertake research and teaching in the United Kingdom in the biological sciences; the scholarships are for persons with some previous experience in postgraduate research in their own subject, and the bursaries for those who have recently graduated, and in both cases the Foundation will pay the cost of university and/or college fees in addition to a maintenance award; applications must be received by April 1. The awards for the social sciences are the same as those for biology except that the application forms must be received by May 1 and the holder may have a degree in any subject other than the social sciences, psychology or economics, though one in the natural sciences or mathematics is preferable; subjects suitable for study are political science, social psychology, anthropology, social statistics and sociology generally, but not economics. Application forms for all these awards and further information can be obtained from the Secretary, Nuffield Foundation, Nuffield Lodge, Regent's Park, London, N.W.1.

Sociological Research in Africa South of the Sahara

A meeting of specialists engaged in the planning of sociological research will be held during the last week of this month in Kampala, Uganda, by the Scientific Council for Africa South of the Sahara, on the occasion of the second seminar of Belgian and British sociological research workers. The meeting will consider present major problems and projects of sociological research in Africa south of the Sahara, and will make suggestions for special studies and means of co-ordination concerning sociological research. Among those who are expected to attend will be Gouverneur Deschamps from the Ministère de la France d'Outre-Mer, Paris; Prof. Griaule, professor of ethnology in the University of Paris; Dr. L. van den Berghe, director of the Institut pour la Recherche Scientifique en Afrique Centrale, Congo Belge; Dr. A. I. Richards, director of the East African Institute of Social Research, Kampala; Prof. A. Mendes Correa, director of the École Supérieure Coloniale, Lisbon; Mr. V. R. Sutton, of the South African National Institute for Personnel Research; and Dr. Clyde Mitchell, director of the Rhodes-Livingstone Museum, Northern Rhodesia.

Announcements

Dr. E. Marsden, representative of New Zealand on the Executive Council of the Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, has been elected chairman of the Council in succession to Mr. J. E. Cummins, representative of the Commonwealth of Australia. Mr. W. F. C. Morton (Union of South Africa) follows Dr. G. R. Bates (Southern Rhodesia) as vice-chairman of the Council.

Applications are invited for Lady Tata Memorial Fund grants, scholarships and fellowships to scientific workers of any nationality for research on diseases of the blood, with special reference to leukæmia, in the academic year beginning October 1 next. Grants are made for research expenses, scholarships are awarded as personal remuneration, their normal value being £600 for whole-time research, and fellowships will be for workers with considerable research experience, the stipend being £1,000 a year. Applications must be submitted before March 31, and the awards will be announced in June. Forms of application and further information can be obtained from the Secretary of the Scientific Advisory Committee, c/o Medical Research Council, 38 Old Queen Street, Westminster, London, S.W.1.

No. 6 of the "Bibliography of Scientific Publications of South Asia", covering India, Burma and Ceylon for the period July–December 1951 (pp. 124. Delhi: South Asia Science Co-operation Office, 1952), includes a catalogue of scientific periodicals besides the usual classified list of titles and supplementary list of new periodicals and changes of name, address, frequency, etc. The periodicals are listed alphabetically by title, and details of scientific periodicals which have ceased to appear but which are still of interest to scientific workers are included. Besides particulars of frequency, size and purpose of the periodicals listed, the catalogue gives the publisher's address and the first date of publication.

Like many of its contemporaries in the petroleum field, *The Lamp*, which is the house organ of the Standard Oil Co. (New Jersey), combines knowledge with entertainment. Issue No. 3 for 1952 is particularly characterized by reproductions of life in the Canary Islands, painted by John Groth. Other features describe a push-button parking-system for cars, in a tall building twenty-five feet wide in Washington, D.C., where seventy-two cars can be automatically garaged in a space which, on the ground, would only accommodate nine; this innovation could well engage the attention of local authorities in congested cities in Great Britain. There is an article on Bermondsey, one of London's oldest boroughs, some account of the Company's oil explorations in foreign lands, and an interesting section on 'hurricane hunters' by the United States Air Weather Service in the Caribbean region.

Erratum. We much regret that in the communication entitled "Height of the Potential Barrier in Barrier Layer Cells" in *Nature* of January 31, p. 219, the graph has been inverted.

NEW SCIENCE BUILDING AT BEDFORD COLLEGE, UNIVERSITY OF LONDON

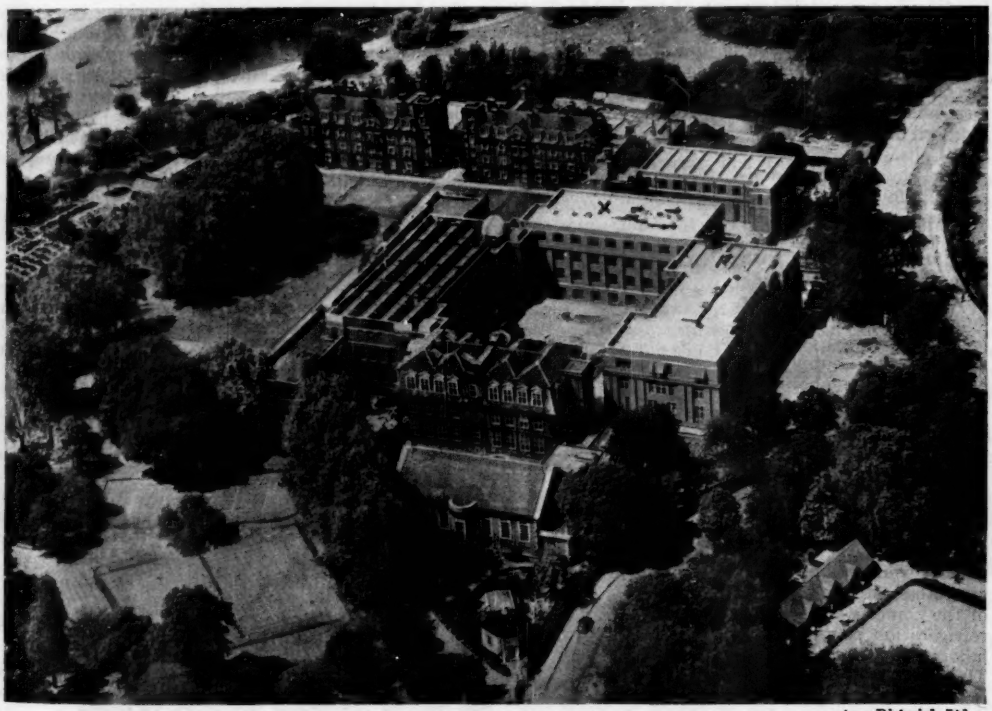
THE Biology and Geology Departments of Bedford College were destroyed by enemy action in 1941. A new building has now been completed on the original site. It was formally opened by the Chancellor of the University of London, the Earl of Athlone, and Princess Alice on October 28 last.

The new structure, of which the architects were Maxwell Ayrton and Partners, has been named the Darwin Building. The name is particularly appropriate for biological and geological laboratories, recalling, as it does, Charles Darwin; but the building is actually dedicated to his son Leonard, who was a member of the College Council during 1898–1925. Another link with the Darwin family is the fact that Erasmus, elder brother of Charles, was an original trustee of the College in 1849 and a member of the Council for nearly twenty years. A grand-daughter of Charles Darwin, Mrs. Ruth Rees Thomas, is to-day a governor of the College.

Zoology is housed on the top story, with botany beneath it and geology on the upper ground floor. Special features of the building are the large windows, valuable for microscopic work, teak benches and floors, heating by ceiling panels, and compressed air and vacuum services. Each department has its own library. A large lecture theatre is common to the three departments, while each of them has its own lecture room. The lower ground floor is shared between the departments and there is a passenger lift.

The Zoology Department (Prof. H. Munro Fox), in the planning of which the senior lecturer, Miss F. E. Ince, gave valuable help, is designed so that a large teaching laboratory occupies two-fifths of the floor space, with windows on three sides. The museum collection is displayed in glass cases around this laboratory. The Department contains individual research rooms for the five members of staff and three research rooms for five postgraduate students, grouped around preparation rooms and stores. The lower ground floor provides a workshop, dark-room, aquarium room, and two constant-temperature rooms. The research work deals at present with respiratory pigments and with the metabolism, osmoregulation, taxonomy and embryology of Crustacea.

The Botany Department (Prof. L. J. Audus), in addition to general and honours teaching laboratories, has a laboratory for instruction in special experimental disciplines (for example, biochemistry, plant physiology, soil chemistry, etc.). The departmental museum collection is housed in glass-fronted cupboards in laboratories and corridors. There are five staff research rooms, a postgraduate research laboratory and a large constant-temperature room provided with high-intensity fluorescent light for growth experiments with plants in artificial day-lengths. Current research is mainly on the physiology of growth, with particular reference to chemical regulators, ecology and wheat genetics. The herbarium has built-in insect-proof cabinets for both teaching and research collections. There are also two dark-rooms, a medium room, a sterile room and a workshop.



Aero Pictorial, Ltd.

Bedford College, University of London. The Darwin Building is marked X

The Geology Department (Prof. L. Hawkes) comprises one large general laboratory and museum, a smaller palæontology laboratory, three research laboratories, a chemical laboratory and a technician's room. Two rooms on the lower ground floor are equipped for rock-cutting and optical work.

CENTRAL PUBLIC HEALTH LABORATORY, COLINDALE

NEW LABORATORY BLOCK

ON January 15 the new laboratory block of the Central Public Health Laboratory at Colindale was formally opened by the Minister of Health. The Minister, accompanied by his Parliamentary Secretary, Miss Hornsby-Smith, Sir John Hawton and Sir John Charles, were met by the chairman of the Medical Research Council (Lord Limerick), the first secretary (Sir Harold Himsworth), the second secretary (Sir Arthur Landsborough Thomson), the director of the Public Health Laboratory Service (Dr. G. S. Wilson), and were conducted over the main buildings by the director of the Colindale Laboratories (Lieut.-Colonel H. J. Bensted).

There were no formal demonstrations set out and the Minister met the heads of the various departments and their staff carrying out their normal duties; of topical interest were the roll-tube tissue culture technique for the cultivation of the poliomyelitis viruses, and the chick embryo cultivation of the influenza virus.

In the library of the new building, the Minister was introduced by Lord Limerick, and in a short address he described the development of the Public Health Laboratory Service and how it came about that the Medical Research Council is directing, and will continue to direct for an indefinite period, this Service for the Ministry of Health. In declaring open the new building he paid tribute to the architect, Mr. Maxwell Ayrton, and the builders, Messrs. Trollope and Colls, Ltd.

The new building consists of a four-floor block of a pleasing brick construction, approximately 180 ft. long and 45 ft. wide, with a central tower extending upwards for a further four floors. The top of the tower houses reinforced concrete water-tanks to supply the needs of all the laboratory buildings. The rooms under this are designed for office and record purposes. A door from the vestibule on the fourth floor leads to the roof space, which runs the full length of the building and in which is housed ventilating plant, air filters, etc., and some of the compressors for the refrigeration units on the laboratory floor below. There is also ample storage accommodation in this space.

A basement under the central part of the building houses more plant and also a gas-fired incinerator, the flue of which passes up to the top of the tower more than 90 ft. above.

The front of the building faces west, and all the windows on that side are protected from the setting sun by green sun-blinds operated from the inside. At the south end there is a service lift for animals and equipment travelling directly to the third floor (Virus Department) without intermediate stops, and at the north end a similar type of lift serves all the other floors. In the centre a passenger lift goes up to the top of the tower. There is a central staircase, broken at the third floor, for normal foot traffic, while there are emergency downstair cases at either end of the corridors.

In designing this laboratory block, one of the principles kept in mind was, so far as possible, to standardize the layout for each floor but at the same time to make provision (should future requirements necessitate it) for alteration in the size of some of the rooms without interfering with the main construction. On each floor, the first rooms at the south end of the building form a suite comprising preparation room, sterilizing and wash-up kitchen, sterile glass-ware store and sterile room, where a positive pressure of filtered air can be maintained. Each floor also has shower-baths and changing rooms. There are also incubator rooms (37·5° C.) and cold rooms (+ 4° C.). Secretarial assistance in adjacent offices is provided for each group of laboratories.

Central corridors run the full length of the building with laboratory rooms approximately 14 ft. deep on either side. Single-unit rooms are just under 8 ft. wide, and two-, three- and four-unit rooms are multiples of this figure in width. The most common size is the standard two-unit room with a working bench across the windows at 2 ft. 9 in. high, containing one small staining sink in the centre and a drip sink for filter pump, etc., at one end. There are a side bench for water-baths, etc., and a washing-up sink with draining board on the opposite side. A convenient double bench is placed centrally, half of which is 3 ft. high, and the other half, serving as a writing desk,

New laboratory block, Central Public Health Laboratory, Colindale

is 2 ft. 6 in. All benching is of teak, and the under-bench furniture is of West African mahogany. The front and side under-bench furniture consists of movable nests of drawers, paired cupboards with adjustable shelves, and open microscope cabinet containers. The central benches are supported by suitable linking of similar cupboard or drawer units.

Simple services are carried on the walls under the benches and consist of electric points, gas, and hot and cold water only. Other gas and electric points are 9 in. above floor-level for small refrigerators, centrifuges and incubators. Ample ceiling lights are provided by opal tungsten lights, while fitted 'Anglepoise' lamps cover each front bench for close work. 'Opalite' shelving for reagents is fitted over staining sinks and at the sides. A capacious double cupboard with adjustable shelving is suitably placed in one corner.

The above description is typical of the standard two-unit room, and although somewhat different arrangements appear in the rooms of other sizes, the same general principles are observed.

The top laboratory floor is devoted to the study of virus diseases, and it is here that refrigeration units are of greatest importance. There is a large + 4° C. room, a − 30° C. room, and inside the latter are chambers maintained at − 70° C. The compressors for these are housed in the roof space. In the centrifuge room on this floor there are also two small independent − 70° C. refrigerator cabinets and a high-speed refrigerated centrifuge. Two animal inoculation rooms with special inoculation boxes connected to exhaust ducts are not quite complete; these ducts are being provided with high-temperature heaters to burn away virus-laden air before it passes out to the open.

The second floor houses the Air Hygiene Laboratories and, under the same director, the Streptococcal and Staphylococcal Reference Laboratories. The novel feature here is an experimental room for research into the bacterial contamination of air. On the same floor is an assembly room for special apparatus required in this section, much of which is machined in an associated outbuilding workshop.

On the first floor are the Food Hygiene Laboratory, Salmonella and the Dysentery Reference Laboratories. These are situated in one-, two- and three-unit rooms of standard design.

The Epidemiological Research Laboratory occupies one-half of the ground floor, the remainder of which consists of small and medium-sized research laboratories for individual workers.

The Routine Department, the Central Enteric Reference Laboratory and Bureau, the Standards Laboratory for Serological Reagents and the Media Kitchens, etc., remain in the old building, but with improved accommodation, while the National Collection of Type Cultures continues to occupy the same rooms as previously.

Owing to economy cuts, it has not been possible to carry out all the improvements originally planned; but it has been possible to convert the old stable, used for inoculating calves when the building belonged to the Government Lymph Establishment, into an excellent research library. It can serve also as a lecture hall for an audience of about a hundred persons, and it was in this very recently completed room that the Minister of Health addressed the invited gathering after his inspection of the new building.

H. J. Bensted

THE 'COMET' AIR-LINER

In a Friday Evening Discourse delivered at the Royal Institution, London, on November 21, Mr. C. T. Wilkins, assistant chief designer of the De Havilland Aircraft Co., Ltd., discussed the new 'Comet' air-liner.

The end of the Second World War left United States aircraft manufacturers with undisputed supremacy in the field of transport aeroplanes. Some six to eight years are needed to bring a modern air-liner into service from the initial design stage, and Mr. Wilkins pointed out that any attempt of the De Havilland Co. to base its designs on United States practice would not have been likely to produce an aeroplane with the necessary competitive margin. Instead, it was decided to draw on the mounting British experience with the jet engine, the main potential gains being speed, absence of vibration and relative simplicity.

The most promising configuration of aeroplane for this engine appeared to be the tail-less with swept-back wings, and a De Havilland 'Vampire' was modified into the 'D.H. 108'. This became the first British aeroplane to fly faster than sound in a dive, while level speeds at a little more than 600 m.p.h. were possible. This layout, when translated into air-liner practice, promised to be only 50 m.p.h. faster than the rather more orthodox configuration now seen in the 'Comet', and this latter was chosen mainly in order to provide a design for which production orders could be prudently made from the 'drawing board'. The British Overseas Airways Corporation, the former British South American Airways Corporation and the Ministry of Supply were courageous enough to give orders for a total of sixteen 'Comets' at that stage. This has meant a saving of two years in getting the aircraft into service due to the elimination of the 'prototype' stage. It took two and three-quarter years from the time that the conception was settled to the first flight, and an equal period until the 'Comet' came into service. The following are some of the problems which had to be solved.

Choice of engine. The 'Comet I' is fitted with the 'Ghost' centrifugal engine. This choice was dictated by expediency, and the later 'Comet' series will have the more powerful and efficient 'axial' engines which are now available.

Flying at high altitude. The optimum altitude for a flight of given stage-length is a function of the aircraft weight, and it therefore changes during flight as the fuel is consumed. A typical cruising procedure worked out for the 'Comet' requires an initial climb to 33,000 ft. in thirty minutes, followed by a gradual ascent to 40,000 ft. At this height the atmospheric pressure is 2 lb./sq. in., a temperature of − 73° C. has been recorded and the air is practically dry. These figures indicate the need for reliably engineered cabin pressurization, heating and humidification. At the time of design, little was known of conditions in the upper atmosphere, and a De Havilland 'Vampire' was adapted for making the necessary high-altitude research. This aeroplane established the present world altitude record of 59,446 ft.

Drag. The critical Mach number of flight above which the 'compressibility' drag rise becomes severe has been kept relatively high by the use of a thin swept-back wing and by careful design of the rest of the aeroplane. This is particularly necessary, since the speed of sound at the cruising altitude is only nine-tenths of its sea-level value.

Tare weight. The pay load of the 'Comet' is one-tenth of its 'all-up weight', while the fuel accounts for 49 per cent of the weight at take-off, and any unexpected changes in the weight of structure or fuel therefore have rather larger effects on the magnitude of the payload. However, the absence of airscrews ameliorates the problem not only due to the direct saving in weight but also due to the considerable reduction in the size of the undercarriage.

Fuel storage. Seven thousand imperial gallons of fuel are fitted into a thin wing of 115 ft. span, since it is inadmissible to use the fuselage for storage. To save space, tanks integral with the wing structure are used. The problems to be overcome here arise from the structural deformation in flight and from the high permeability of kerosine. The use of metal-to-metal bonding is superior to the classical riveted joints in this connexion, and it is used extensively throughout the 'Comet'. The fuel should be carried far out along the wing in order to reduce the bending moment at the wing root. In a swept wing this presents problems of the shift of centre of gravity, and the order of fuel usage becomes important. Kerosine is a safer fuel than petrol, but fire precautions are taken very seriously since the relighting of 'cut' engines is to take place in the air.

Controls. The achievement of light control-surface operation is possible by aerodynamic means or by the use of power operation. The former alternative was decided against, in view of the long time usually taken in the early flight-trials to get the controls 'right'. No other useful flight-tests are possible until this stage is reached. A power-operated system, however, may be given thousands of hours of use in a ground rig in which most of the conditions of flight are simulated. For safety, each control is provided with two entirely independent power-units.

The solution of these and many other problems is the business of a design team consisting of designers, aerodynamicists and stress-men. Further necessary departments are structural testing, experimental, production and service. The organization is now developing the 'Comet II', which is the original machine modified to take the more powerful Rolls Royce 'Avon' engine, and the 'Comet III', a larger aeroplane altogether.

BRITISH GELATINE AND GLUE RESEARCH ASSOCIATION

THE sixth meeting of the Research Panel of the British Gelatine and Glue Research Association was held at Beale's Restaurant, London, N.7, on November 27, 1952, with Mr. S. G. Hudson (Richard Hodgson and Sons, Ltd.), chairman of the Association, in the chair. Seventy-two persons attended the meeting, including representatives of the manufacturers of plant for the industry.

The meeting was the first held by the Association at which the papers were concerned with practical questions closely related to manufacture. This provided increased opportunity for discussion, of which full advantage was taken. The first paper, "Tannery Treatment of Pieces and Fleshings", by Dr. W. E. Braybrooks (Stokes and Co., Ltd.), described the processes to which the raw materials of the hide gelatine and glue industry are subjected in the tannery prior to dispatch to the gelatine works. The effect was discussed of short dehairing processes, using rotating drums in place of lime pits, on the hide itself, and often using substantial quantities of sodium sulphide in addition to lime.

In the second paper, "The Extraction of Hides", Mr. D. Fysh, of the Association's staff, described a series of experiments in which the industrial treatment of hides by lime suspensions, followed by neutralization, and then extraction of gelatine, was repeated on the laboratory scale. This enabled a number of variables to be studied, such as *p*H of extraction, time and temperature of extraction, period of lime treatment, etc. The gelatine produced was evaluated by means of measurements of its physical properties. The third paper was by Mr. D. B. Hall (John Knight, Ltd.), entitled "Bones Processing", in which he presented a detailed account of the origin, handling and processing of the raw material of the bone glue factory. The stage-by-stage analysis of the process showed the problems which arise in the various plant operations. Dr. E. M. Vyner (Sheppy Glue and Chemical Works, Ltd.) gave the final paper, under the title "Aspects of the Evaporation and Drying Process in the Glue and Gelatine Industry". Dr. Vyner reviewed the many possible methods by which a dry end-product may be obtained from a gelatine or glue solution. Apart from the normal methods of multi-effect evaporation, setting and drying, spray-drying and freeze-drying have been tried.

On the previous day, at the annual general meeting, Mr. G. W. Odey, chairman of Barrow, Hepburn and Gale, Ltd., was re-elected president of the Association. The chairman of the Association, Mr. S. G. Hudson, stressed the importance to firms using gelatine and glue of the work on this aspect being commenced by the Association. The director of research, Mr. A. G. Ward, in his report, and Sir Roger Duncalfe, chairman of British Glues and Chemicals, Ltd., who proposed a vote of thanks to the council and staff, both emphasized the value of close contact between the Association and the industry.

CAREERS IN BIOLOGY

THE Institute of Biology recently held a second symposium on "Biology as a Career", at which were discussed fields not covered by the Edinburgh conference (*Nature*, **169**, 1034; 1952). A theme common to many of the papers was the need for more biologists having a better training in chemistry and physics.

Sir Harold Himsworth (secretary, Medical Research Council) said that in modern medical research the collaboration of workers from many scientific disciplines is needed. On the scientific staff of the Medical Research Council there are some 440 graduates of whom one-third are medically qualified. Apart from the National Institute for Medical Research, the majority of the Council's staff work in special units which are similar in constitution and size to university professorial units and most of which are associated with universities. In addition, the Council has a system of scholarships for training in research methods. These are designed to enable first-degree graduates to supplement their training and experience in order to equip them for biological research in many fields for which competence in several branches of natural science is necessary. It is perhaps significant that, of those who have received

grants, more than half needed training in chemistry and a quarter in anatomy, physiology, pharmacology, embryology or histology.

The work of the Agricultural Research Council in promoting investigations on fundamental problems as well as work of immediate importance was described by its secretary, Sir William Slater. Research is carried out in twenty-three research institutes and units and through some 150 research grants to individuals: this involves an annual expenditure of about £3,000,000. Biologists can be divided into 'naturalists' (or observers) and 'experimentalists'. Both types are needed by the Agricultural Research Council, which employs some 190 'naturalists' and 430 'experimentalists'. It is desirable that a person be well trained as an experimentalist or a naturalist with a general knowledge of the other aspect of his subject, but those poorly trained in both aspects are very difficult to place.

Dr. G. A. C. Herklots (secretary for Colonial Agricultural Research, Colonial Office) described how agricultural research in the Colonies is being developed, and gave details of the work carried out on some problems of considerable economic importance. A Colonial agricultural officer is selected from graduates in biology or agriculture and has two years further training, first in England and then in Trinidad. He then goes to a Colony as an adviser for an area, where he has the assistance of specialists working in a commodity, or a regional, research institute. To assist small Colonies with little or no resident specialists, pools of experts have been established in Britain so that a person can be sent to investigate *ad hoc* problems.

The attainments needed by a person attempting to solve the complex problems arising in applied entomology were given by Dr. W. E. Ripper (Pest Control, Ltd.) as a good knowledge of insect physiology and taxonomy, fair chemistry, some botany and a good grounding in methods. Dr. Ripper looks forward to applied entomology being practised in a manner similar to medicine by a self-governing profession.

The emergence of the antibiotics industry and developments in food processing are considered by Mr. H. J. Bunker (Barclay Perkins, Ltd.) to have accentuated the demand for microbiologists, resulting in favourable prospects of employment for those suitably trained. A biological subject with chemistry as subsidiary is the more desirable combination as a basis for a career in microbiology. Courses, sometimes specialized for a particular field, are offered by a number of universities, but there are as yet insufficient honours degree courses.

STATISTICAL METHOD IN TRANSPORT MANAGEMENT

THE number of suggested definitions of statistics runs into hundreds: many of them are practically indistinguishable one from another, but there have grown up, during the first half of this century, two main schools of thought on the subject. One (with history on its side) regards statistics primarily as the routine and exhaustive compilation of data and their arrangement into tables capable of revealing the required information, if not at a glance, at least without any esoteric mathematical manipulations; the other tends to stress the more modern concept of statistics as the science of drawing, by arguments depending on the theory of probability, generally valid conclusions from particular bodies of data, acquired either by a sampling process or as a product of experiment.

Statistics of the first type has always been an indispensable adjunct to management, whether of a State, a hospital, a factory, or a public undertaking such as the London Transport Executive. More recently, however, the 'small-sample' methods of the second school, developed first for research in biology and later applied to industrial experimentation, have become accepted as potentially valuable tools for managements anxious to investigate not merely the occurrence but also the reasons for the occurrence of observed social phenomena. A public-transport undertaking cannot reasonably hope to run at full efficiency without some knowledge, on one hand, of the social habits and requirements of its potential users and, on the other, of the various changeable factors which may affect such quantities as journey times, fuel consumption, accident-rates, and the useful life of vehicles. These problems have been intensively studied by the London Transport Executive; some results of its sample survey of the travelling habits of the London public were given in the "London Travel Survey"[1], and Mr. F. A. A. Menzler, chief development and research officer of the Executive, has now given, in his paper on "Statistical Methods and Operational Research in Transport", read before the Institute of Transport on November 17, 1952, some examples of the methods in use for the study of routine vehicle operation.

The 'control chart' method, extensively developed during the Second World War for the control of mass-production processes, has many obvious applications in routine management. Mr. Menzler gives examples of its use for investigating weekly failure-rates of various components, including an analysis of puncture-rates in which the control-chart exhibited a periodic fluctuation.

Many investigations have been made of 'passenger habits', some by selective observation, others by actually interviewing a sample of passengers. Habits studied include boarding and alighting at or between stops (the results were used in conjunction with accident statistics to determine the relative dangers of these practices—a nice example of the use of operational research methods to assist in the interpretation of routine statistics), and use of destination blinds. (It appeared that "a substantial proportion rely upon word-of-mouth sources of information, and are mistrustful of notices, maps or posters".)

The standard methods of experimental design, derived to eliminate and allow for the effects of heterogeneous biological material, can be profitably used in dealing with the even more heterogeneous conditions prevailing in transport operation. Mr. Menzler describes, among others, a 'latin square' design used in comparing the fuel consumed by various driving techniques, and a 'cross-over' design used to study the effects of different carburettor settings. Also described is an interesting example of a regression analysis illustrating the amounts by which various causes contributed to an increase in fuel consumption for 1951 over that for 1950.

Mr. Menzler ends by asserting, clearly with reason, that "there are few aspects of transport operation and engineering that might not gain from operational research".

M. R. SAMPFORD

[1] London Transport Executive, 1949.

INHIBITION OF TUMOUR GROWTH BY D-GLUCOSAMINE

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THIS article constitutes a preliminary report of our experiments on the effects of D-glucosamine on the inhibition of tumour growth in mice.

Our interest in D-glucosamine arose with the work of Harpur and Quastel[1] on the phosphorylation of D-glucosamine by adenosine triphosphate in presence of hexokinase of brain tissue. Brown[2] showed that this reaction also occurs in the presence of yeast hexokinase, D-glucosamine-6-phosphate being formed. A competition between glucose, fructose and D-glucosamine takes place in brain tirsue for the enzyme responsible for the phosphorylation of these sugars[1], the affinities of fructose and D-glucosamine for the enzyme being of the same order and less than that of glucose. Harpur and Quastel[3] then observed that the rate of acetylcholine synthesis in brain extracts is inhibited by the presence of D-glucosamine. This is due to the fact that the process of phosphorylation of D-glucosamine diminishes the amount of adenosine triphosphate available for the acetylcholine synthesis. It thus became clear that the addition of D-glucosamine to a tissue may provide a means of diverting adenosine triphosphate from its normal metabolic paths.

Owing to the fact that the energy required by rapidly proliferating tumour cells for their synthetic processes seems to come largely from the breakdown of glucose and the participation of adenosine triphosphate, it seemed possible that administration of D-glucosamine in sufficiently large quantities into tumour-bearing animals might divert adenosine triphosphate activity sufficiently to affect the rates of the metabolic paths involved in tumour proliferation. Even if the diversion only occurred to a small extent, it might be large enough to impede the rate of proliferation of the rapidly growing tumour cells.

Accordingly, experiments have been carried out during the past two and a half years to observe the effects of the administration of D-glucosamine to mice bearing the tumour sarcoma 37. The results indicate that at concentrations of D-glucosamine which produce no adverse effects on the normal animal, and which give rise to no signs of shock or toxicity, a marked inhibitive effect on the growth of the tumours takes place. The survival-rate of the tumour-bearing animals is practically doubled, while the value for the activity of liver catalase, which is lowered in the presence of tumours, is considerably increased after D-glucosamine administration. It is to be noted, however, that Lustig and Wachtel[4] have examined the effects of a large number of substances of biochemical interest (alkaloids, amino-acids, sugars, amines, and also D-glucosamine) on the development of Ehrlich mouse carcinoma, and reported D-glucosamine to be without effect.

Experimental Details

Animals. Experiments were carried out with mice of the *C.F.W.* strain, as well as with a strain of hybrid albino mice supplied locally. The tumour (sarcoma 37) used was originally obtained from the National Cancer Institute, Bethesda, Maryland. Transplantation of the tumour was carried out by injection, either into the right flank or the right hindquarter of the mouse, of approximately 0·05 ml. of a tumour mash composed of 1 volume of minced tumour tissue diluted with 1 volume of 0·9 per cent sodium chloride solution. This preparation of tumour mash, which was obtained with aseptic precautions, gave a high percentage of successful grafts. The tumours were six days old when they were used for transplantation. They were then usually between 0·5 and 1·0 cm. in diameter, and were well vascularized and showed no necrosis.

Spontaneous regressions were very rare in the animal strains employed once a palpable tumour had been observed, that is, when the inoculant had been successfully grafted and no bacterial contamination had taken place.

Technique. Groups of twenty animals, male and female, were used in this investigation, ten animals in each group serving as untreated controls.

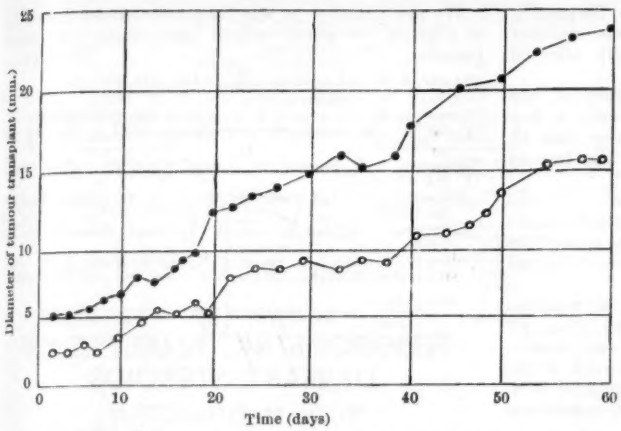
Aqueous neutral solutions of D-glucosamine hydrochloride, or of other substances, were injected intraperitoneally into mice bearing four- to six-day old tumours. Daily injections of either 0·1 ml. (containing 2·5 mgm. D-glucosamine hydrochloride) or 0·2 ml. (5 mgm.) were made and the tumours were examined daily for regression or inhibition of growth. In one group of experiments injections were given the day following implantation of the tumours with subsequent daily injections. The injected mice were carefully compared with equal numbers of control untreated tumour-bearing mice, at least ten animals being used for each test. The animals were usually killed after three weeks and the tumours examined for gross and microscopic effects. Representative slices of the tumours were fixed in Zenker–formol solution, sectioned, and stained with hæmatoxylin-eosin and evaluated histologically.

Rate of development of sarcoma 37 *in C.F.W. mice* (Carworth Farms mice). Typical results showing the effects of D-glucosamine injection on the growth of the tumours are given in the accompanying graph. It is obvious that the administration of D-glucosamine brings about a marked inhibition in the rate of growth of the tumour. At the given rates of admin-

Table 1. Mortality of Tumour-bearing Mice, with and without D-Glucosamine Hydrochloride Administration

Treatment of the groups of 20 mice in single daily doses started 2–6 days after transplant. The average survival-time for mice treated with D-glucosamine was 70–80 days, whereas that for untreated mice or those treated with glucose was 30–40 days

Treatment of groups of 20 mice	No. of animals dead 20–50 days following tumour implantation	No. of animals dead 50–100 days following tumour implantation
Control. No treatment	20	0
0·1 ml. (2·5 mgm.) D-glucosamine hydrochloride injected daily	2	18
0·1 ml. (2·5 mgm.) D-glucose injected daily	19	1
0·2 ml. (5 mgm.) D-glucosamine hydrochloride injected daily	0	20
0·2 ml. (5 mgm.) D-glucose injected daily	19	1



Rate of development of sarcoma 37 in groups of *C.F.W.* mice, with and without D-glucosamine treatment

●, Control mice, after 6-day transplant (ten animals per group); ○, mice, after 6-day transplant, injected daily with 0·2 ml. D-glucosamine hydrochloride (5 mgm.) solution (ten animals per group)

istration of D-glucosamine no complete inhibition of the development of the tumour takes place. A considerable retardation in the development of the tumour mass, however, occurs.

Mortality of the tumour-bearing mice. While all the implanted animals die between twenty and forty days following tumour implantation, the majority dying between thirty and forty days, those animals that have been injected with D-glucosamine hydrochloride survive this period and usually do not die until between seventy and eighty days following the implantation of the tumour. Some animals have survived for a hundred days. This has not been found to occur in tumour-bearing animals that have not been treated with D-glucosamine. Administration of glucose instead of D-glucosamine in approximately the same amount has no effect on the mortality-rate of mice bearing sarcoma 37. Typical results of these experiments are shown in Table 1, and indicate the specific activity of D-glucosamine in affecting the survival-rate of the tumour-bearing mice.

Liver catalase of C.F.W. mice. As is now well known, the amount of catalase in livers of tumour-bearing mice is lower than that of the normal animals[5–7]. Expressing liver catalase activity in ml. of oxygen produced per second, using the technique of Greenstein and Andervont[6], the liver catalase for normal mice is found to vary between 1·0 and 3·0. The liver catalase, however, of mice bearing sarcoma 37 falls to between 0·1 and 0·5 after forty days following the transplantation of the tumour. When mice bearing sarcoma 37 are injected daily with D-glucosamine solution (2·5 mgm.), the liver catalase activity forty days after transplantation has a value of 1·7. In certain animals, the activity even at seventy-five days is 1·0, and at eighty-five days following transplantation it is 1·2. With mice bearing sarcoma 37, which have been given glucose injections instead of D-glucosamine, the liver catalase activity is not increased.

It is therefore clear that administration of D-glucosamine to tumour-bearing mice not only results in a retardation of tumour growth but also in a marked diminution of the rate of fall of the catalase activity of the liver. The results given in Table 2 indicate these findings, and show also that the removal of tumours from mice bearing sarcoma 37, after forty days transplantation, also results in an increase of the liver catalase activity.

Table 2. LIVER CATALASE ACTIVITY OF TUMOUR-BEARING *C.F.W.* MICE, WITH AND WITHOUT D-GLUCOSAMINE HYDROCHLORIDE ADMINISTRATION

Activity expressed as ml. oxygen/sec. (Greenstein and Andervont, ref. 6). Results are the average for ten mice (average weight, 23·5 gm.)

	Activity
Normal *C.F.W.* mice	1·0–3·0
Sarcoma-37 mice after 40 days. (6 days transplant.) No treatment	0·1–0·5
Sarcoma-37 mice after 40 days. Treated daily with D-glucosamine hydrochloride (5 mgm.)	1·7
Sarcoma-37 mice after 40 days. Treated daily with D-glucose (5 mgm.)	0·1
Sarcoma-37 mice after 40 days. Untreated but tumour removed	1·8

Effects of administration of glucose–ammonium sulphate mixtures. Experiments were carried out to observe whether administration of mixtures of equimolecular quantities of glucose and ammonium sulphate might have effects resembling those of D-glucosamine on mice bearing sarcoma 37. An injection of 2 ml. of a mixture containing 90 mgm. glucose and 67 mgm. ammonium sulphate per ml. into groups of ten mice of mixed sexes was followed by the death of all the animals three days after the injection. Death was due to pulmonary œdema and toxic hepatitis. The minimum lethal dose of the mixture was 0·1 ml. Injection of this quantity into the mice had no toxic effects on sarcoma transplants following ten daily injections. No regression of the tumour mass, nor toxic hepatitis, nor pulmonary œdema was found. Injection of ammonium sulphate solution alone at the minimum lethal dose of 0·1 ml. caused no regression of the tumour mass. Injection of larger quantities—1·0–3·0 ml. of the ammonium sulphate solution—gave rise to toxic effects on lung, liver and kidney. But even in these circumstances no effects on the tumour mass were found during the time that the animals survived.

The results of these experiments seem to indicate that the cytotoxic effects of D-glucosamine on sarcoma 37, and the inhibition of tumour growth, cannot be ascribed to the liberation of ammonia by decomposition of the glucosamine.

Pathological findings following D-glucosamine administration. After the injection of D-glucosamine into mice bearing sarcoma 37, there usually appears extensive hæmorrhagic areas in the tumours, which also show some softening. This may occur 24–48 hr. after the initial injection when the tumour shows diffused hæmorrhage.

The microscopic findings resemble the gross findings. Cytotoxic effects, due to D-glucosamine injection, are obvious. The earliest damage is observed after about two hours, when there occurs a shrinkage of the nuclei, retraction of cytoplasm and marked eosinophilia. Between 6 and 8 hr., further degeneration takes place. The nuclei become markedly pycnotic with further cytoplasmic retraction and definite eosinophilia.

At a later stage, there is stasis with more extensive pycnosis and necrosis. This is soon followed by the production of distorted mitotic figures. After 48 hr.,

normal proliferating cells may be seen frequently at the periphery of the tumour, while cellular disintegration is observed in the severely affected portion.

The necrosis is followed later by autolysis, the supporting structure is destroyed and only a few abnormal cells, mostly near the periphery, can be distinguished. The tumour decreases in size but no complete regression has been noted.

Effects of D-glucosamine administration to normal animals. No toxic effects, or signs of shock, have been noticed when D-glucosamine, in the quantities mentioned, are injected intraperitoneally into normal mice.

A routine histological examination of all animals treated with D-glucosamine has shown that no abnormal effects are present in the liver, spleen, kidneys, suprarenals, or the intestinal mucosa of the animals. Blood counts (red and white cells) of both normal mice and tumour-bearing mice are unaffected by D-glucosamine administration.

Too few experiments have yet been carried out to discover whether injections of high concentrations of D-glucosamine will bring about abnormal changes in the animal tissues. So far, we have observed no toxic symptoms in normal animals following D-glucosamine injections.

Conclusions

The observations recorded indicate that the administration of D-glucosamine to mice bearing the tumour sarcoma 37 results in a marked inhibition of the rate of growth of the tumour and in the development of cytotoxic effects in the tumour itself. No complete regression of the tumour has been observed under our experimental conditions, but the results indicate a marked specificity of action of the substance on the tumour mass as compared with that on the host tissue. Many substances are now known to have cytotoxic effects on tumours, but it is the relative inactivity of D-glucosamine on the host tissue which is a striking feature. The fact that the liver catalase activity does not diminish to the same extent in animals that have been treated with glucosamine as in those that have not been so treated is in agreement with the pathological findings. The survival-rate of tumour-bearing mice treated with D-glucosamine is considerably greater than that of untreated animals, and gives rise to the hope that D-glucosamine (or its derivatives) may represent a substance with distinct chemotherapeutic possibilities.

It is significant that D-glucosamine was investigated because of its ability either to compete with glucose in its initial reactions with adenosine triphosphate, or to divert the latter substance from its normal metabolic pathway in tumours. The cytotoxic effects of D-glucosamine on sarcoma 37 do not necessarily mean that the substance is behaving in the manner that has been pictured. The results do indicate, however, that this line of approach may be well worth following up. It seems to us very possible that D-glucosamine derivatives or analogues may be found which are much more effective than D-glucosamine itself, and that these substances, while having relatively little effect on the host tissue, may bring about marked changes in the rate of development of the tumour. Very recent experiments of Ikawa *et al.*[8] seem to indicate that certain polysaccharides having tumour-inhibiting properties possess D-glucosamine as part of their structure.

We are grateful to the National Cancer Institute of Canada for grants which have made this work possible. [Dec. 11.

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FLUOROMETRIC ANALYSIS OF URINARY STEROIDS

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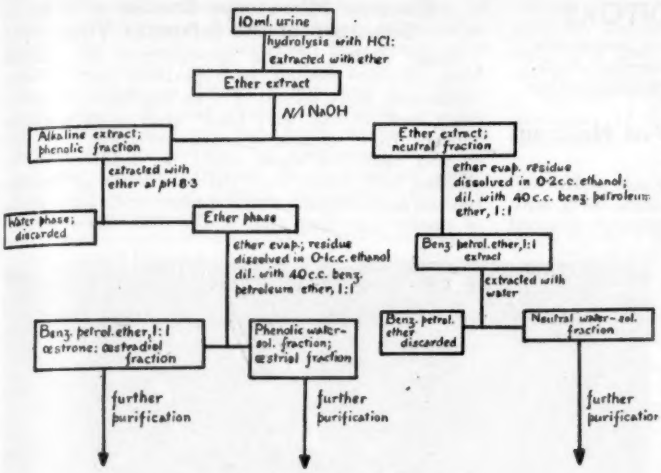
THE study of the metabolism of œstrogenic hormones was made difficult by the lack of suitable quantitative methods for the determination of the three naturally occurring œstrogens, namely, œstradiol, œstrone and œstriol, and of their metabolites.

To meet this difficulty in part, with the collaboration of Drs. Hestrin and Koch, I elaborated, some years ago, a fluorometric method for the quantitative determination of crystalline œstrone, œstradiol and œstriol[1]. This method was based on the old observation of Wieland, Straub and Dorfmueller[2] and of Marrian[3] that these œstrogens when heated with sulphuric acid develop a bluish-green fluorescence. We have found, however, that sulphuric acid was not suitable for quantitative determination, because high and irregular blank readings were encountered and the reproducibility of the results was unsatisfactory. Phosphoric acid, on the other hand, showed only negligible blank readings, and by taking suitable precautions a linear relationship between the concentration of any of the œstrogens and of the fluorescence intensity was obtained.

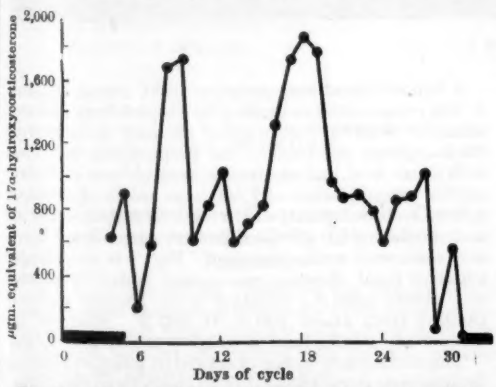
As the ultimate object of our study was to adapt this method for the determination of the œstrogenic hormones in urine and blood, attempts were made to make use of existing partition methods for the urinary œstrogens and to apply the fluorometric measurements to the purified fractions. However, it soon became evident by comparison of the fluorometric results with bioassay and also from recovery experiments that the fractions under investigation contained some substances, different from the œstrogens, which interfered with the fluorometric readings. This led us to re-investigate the partition procedure and, as a result, a modified partition method was developed[4]. The accompanying chart shows schematically the course adopted; crude extract has thus been divided into three fractions: (1) œstrone–œstradiol fraction, (2) œstriol fraction, and (3) neutral water-soluble fraction. Recovery experiments using this partition procedure gave satisfactory results both in the œstrone–œstradiol and in the œstriol fraction. As little as 20 γ of any of these œstrogens added to 1 litre of urine could be determined with an accuracy of $\pm$ 20 per cent. Comparison of results obtained by bioassay and fluorometry performed on several samples of preg-


10 ml. urine
hydrolysis with HCl: extracted with ether
Ether extract
N/1 NaOH
Alkaline extract; phenolic fraction
Ether extract; neutral fraction
extracted with ether at pH 8·3
ether evap. residue dissolved in 0·2 c.c. ethanol; dil. with 40 c.c. benz. petroleum ether, 1:1
Water phase; discarded
Ether phase
ether evap.; residue dissolved in 0·1 c.c. ethanol dil. with 40 c.c. benz. petroleum ether, 1:1
Benz. petrol. ether, 1:1 extract
extracted with water
Benz. petrol. ether, 1:1 œstrone; œstradiol fraction
Phenolic water-sol. fraction; œstriol fraction
Benz. petrol. ether discarded
Neutral water-sol. fraction
further purification
further purification
further purification

Partition of the crude urinary extract

nancy urine showed good agreement in respect of concentrations of œstrone and œstriol. Urine of normal menstruating women yielded also a comparable result by both methods. On the other hand, fluorometric analysis of normal male urine consistently furnished values of œstrone about five times higher than the values obtained by bioassay. We have also obtained the same ratio when analysing urine of two female pseudohermaphrodites. It seems to us that in both cases we are dealing with one substance, which may prove to be a metabolite of the œstrogens.

With regard to the neutral water-soluble fraction, we have observed that it also contains some substance, or substances, which on treatment with phosphoric acid give rise to fluorescence. This fluorescence was usually somewhat more intense in the case of male urine than in normal female urine. Calculated in terms of 17-hydroxycorticosterone, the mean excretion of the fluorogenic material was about 1,300 γ/litre in the case of male and about 800 γ/litre in female urine. With the collaboration of Miss Berlin, we have carried out daily analyses of female urine throughout the menstrual cycle. Two peaks in excretion were usually observed: one at about the tenth day of the cycle and the second at about the twentieth day (see graph). Urine of postmenopausal women did not show these cyclic changes, but day-to-day fluctuations were recorded.



Excretion of the neutral fluorogenic substance during a menstrual cycle

A very pronounced increase in the excretion, about five times higher than in the normal female, was found in the case of the two female pseudohermaphrodites previously mentioned[5]. The excretion of the fluorogenic material in these cases was 4,000–5,000 γ per litre urine, and was fairly constant. The urine of these patients seemed to us to be a good source for isolation purposes, and accordingly we carried out the extraction and partition of about 100 litres of urine. The neutral water-soluble fraction was sent to Prof. T. Reichstein; he isolated three crystalline compounds, one of which showed the characteristic fluorescence. Work on the identification of these compounds is now in progress in Prof. Reichstein's laboratory in Basle.

In addition to the two female pseudohermaphrodites, we have found thus far an increased excretion of the fluorogenic substance in one case of arrhenoblastoma, and constantly in late pregnancy urine. There it amounts to about 2–4 mgm. per litre urine. Injection of 300 mgm. adrenocorticotropic hormone in daily doses of 100 mgm. resulted also in a four-fold increase over the control period.

Since some corticosteroids also produce fluorescence on being heated with phosphoric acid, the question arose whether the increased excretion might be attributed to their presence in the neutral water-soluble fraction. Parallel determination of urinary extracts for corticosteroids and for the fluorogenic substance did not result in a positive correlation.

In the case of the two pseudohermaphrodites, the excretion of corticosteroids was either within normal limits or only very slightly elevated, whereas the fluorometric values were much above 'normal'. In cases of the Cushing syndrome and in several cases of hirsutism and virilism, excretion of corticosteroids was increased, whereas excretion of the fluorogenic substance was unchanged. A marked increase in excretion of both corticosteroids and the fluorogenic substance was observed only in late pregnancy urine.

Isolation studies have been undertaken in order to determine whether the excretion of the fluorogenic material in the cases cited here consists of one and the same compound, or whether we are dealing with several fluorogenic compounds.

I would like to express my thanks to the staff of the Hormone Research Laboratory of the Hebrew University for their collaboration, and to Prof. Bernhard Zondek for his guidance during the performance of these experiments. My thanks are also due to Prof. C. W. Shoppee, University College, Swansea, for his valuable suggestions made in the course of the preparation of the manuscript. [Sept. 12.

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[3] Wieland, H., Straub, W., and Dorfmueller, T., *Z. physiol. Chem.*, **186**, 97 (1929).
[3] Marrian, G. F., *Biochem. J.*, **24**, 435 (1930).
[4] Finkelstein, M., *Acta Endocrinol.*, **10**, 149 (1952).
[5] Zondek, B., and Finkelstein, M., *Nature*, **168**, 831 (1951).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Effects of Daily Irradiation by Fast Neutrons on Male Fertility

Since January 1, 1951, the smaller pile at Harwell has been used for irradiating *CBA* mice daily with fast neutrons. These were fission neutrons obtained by allowing thermal neutrons escaping from the graphite reflector to interact with uranium on the floor of the compartments in which the animals were housed. It is believed that less than 5 per cent of the biological effects produced was due to contaminating radiations. Dose-rates were measured with homogeneous 'tissue' ($C_{0\cdot 15}$ $H_{1\cdot 00}$ $N_{0\cdot 04}$ $O_{0\cdot 42}$) and hydrocarbon (CH) ionization chambers, an allowance being made for gamma-ray ionization by simultaneous readings with an argon chamber[1].

The purpose of this preliminary report is to record the unexpected sensitivity of the mouse testis. A dose of 70 rep. at the weekly dose-rate of 8·3 rep. reduced the fertility of *CBA* mice to half that of controls, using a standard mating test in which the test male is left for four nights with four *CBA* females aged 2–5 months. An accumulated dose of 100 rep. halved the average weight of the testis, and after the same dose there has been no recovery of fertility at any time right up to the age at which unirradiated controls become naturally sterile.

In contrast, the female *CBA* mouse was less sensitive to the sterilizing effects of fast neutrons. An accumulated dose of 140 rep. in seventeen weeks did not seem to affect the ability to conceive or produce young.

The difference in sex sensitivity is opposite to that usually accepted for X- and gamma-rays[2], and the low dose for absolute sterilization in males is also noteworthy[3]. The dose-rate which produced such striking testicular damage had no effect on growth-rate or body-weight for thirty-five weeks, produced no great hæmatological changes by the time the male mice were permanently sterile, and did not appear to produce cataracts until some time after considerable losses in weight occurred.

G. J. Neary
R. J. Munson
R. H. Mole

Medical Research Council
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Atomic Energy Research Establishment,
Harwell, Didcot, Berks. Nov. 11.

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Electron Microscope Studies of the Structure of the Influenza Virus

From studies of the growth-cycle of influenza virus, Hoyle[1,2] formed the hypothesis that the virus elementary body consisted of an aggregate of smaller units, and Burnet and Lind[3] arrived at a similar concept from studies of virus variation. Hoyle[2,4] showed that the virus could be disintegrated by shaking with ether, with the production of separate red-cell agglutinating and complement-fixing particles of smaller size than that of the elementary body.

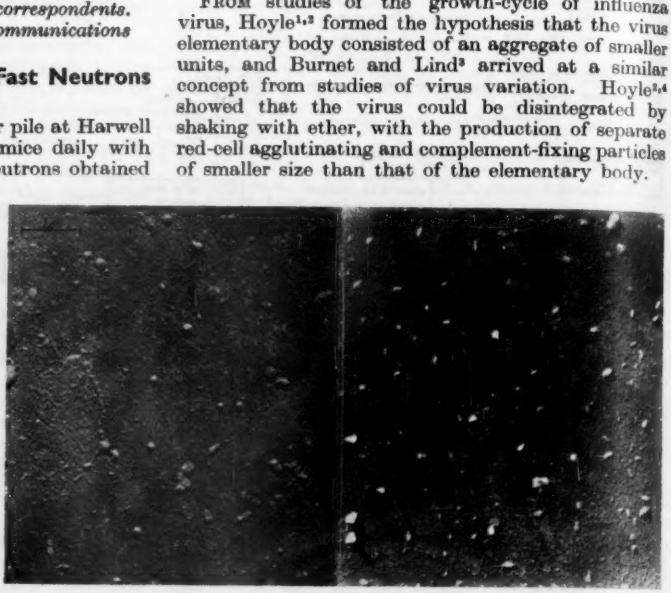

Fig. 1

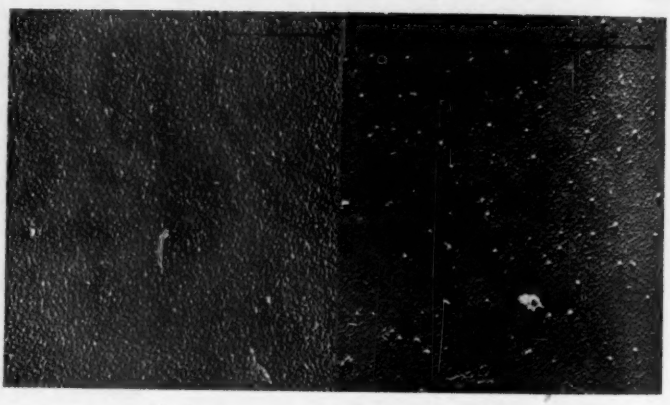

Fig. 2

Fig. 3

Fig. 4

A concentrated suspension of *DSP* strain of virus *A* was prepared as described by Hoyle[4] from infected allantoic fluid by adsorption on and elution from chick-embryo red cells. The preparation was fixed with osmic acid, and electron micrographs at an instrumental magnification of 7,500 were taken of drops on collodion-filmed grids, which were first drained, dried and washed with distilled water, then dried again and shadowed with chromium. Fig. 1 is an enlarged negative print showing elementary bodies of average size about 1250 A., together with smaller particles ranging from about 100 A. to 500 A. Many of the elementary bodies have a roughly hexagonal outline.

The elementary bodies observed in infected allantoic fluid appear to be released from the cells of the chorio-allantoic membrane by a process of cytoplasmic disintegration; but a similar disintegration may occur

in normal cells, with the result that particles of cytoplasmic origin are found also in normal allantoic fluid[2]. Fig. 2 shows an electron micrograph of a preparation made from uninfected allantoic fluid. Large particles are present; but they are rather smaller than the virus elementary bodies, and are more flattened and less regular in outline. These particles may be derived by disintegration of the cytoplasm of desquamated chorio-allantoic membrane cells present in normal allantoic fluid. They do not agglutinate red cells.

When the suspension of *DSP* virus was shaken with ether and then incubated overnight, the elementary bodies were completely disintegrated and the ether-treated suspension showed only a great number of small particles ranging from about 100 A. to 500 A. By adsorption with red cells this suspension could be fractionated into two components: a red-cell agglutinating fraction recoverable from the red cells by elution, and a complement-fixing fraction not adsorbed by the cells. The properties of these fractions have been described[4].

Fig. 3 is an electron micrograph of the complement-fixing 'soluble antigen' fraction. It shows numerous small particles mostly of size about 120 A. There is also a fair number of about twice that size; but larger particles are very infrequent. Filtration of the preparation through a 'Gradocol' membrane of average pore diameter 300 A. removed both the particles and the complement-fixing antigen.

The red-cell agglutinin fraction (Fig. 4) shows a greater range of particle sizes. Numerous particles of about 120 A. are present; but there are also many others of larger size, notably about 500 A. Adsorption of the preparation with red cells removes both the smaller and larger particles, and both can be recovered by elution.

The concept that the influenza virus elementary body consists of an aggregate of smaller units is therefore supported by electron microscope studies. It seems clear that the particles seen in the electron micrographs include those that carry the biological properties of the two fractions, and moreover the indications are that both the red-cell agglutinin and the complement-fixing antigen have a particle size of about 120 A., the larger particles being probably aggregates.

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Nov. 18.

[1] Hoyle, L., *Brit. J. Exp. Path.*, **29**, 390 (1948).
[2] Hoyle, L., *J. Hygiene Camb.*, **48**, 277 (1950).
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Application of the Quantum Hit Theory to Tumours induced by Ultra-violet Radiation

We have previously described the application of the quantum theoretical hit theory to tumours induced by carcinogenic hydrocarbons[1] and by viruses[2]. We have now applied the theory also to skin tumours induced by ultra-violet radiation.

In the experiments of Blum, Grady and Kirby-Smith[3], several groups of mice were irradiated with various doses, D, of ultra-violet light, given at different regular intervals of time, t_i. The mean induction time, $\bar{t}$, between the first irradiation and the appearance of the first tumour was measured as a function of D and t_i. According to our theory, the variation of $\bar{t}$ with D and t_i should follow the expression:

$$\bar{t} = \frac{t_i}{k_0 D} + T. \qquad (1)$$

Here k_0 and T are two constants, the former denoting the probability per unit time and unit dose of an excitation of a cell by the ultra-violet radiation, the latter denoting the mean time of growth of a tumour from the time of excitation to the time at which the tumour has grown sufficiently to be palpable or visually detectable. From (1) we see that if $\bar{t}$ is plotted against $1/D$, we should get straight lines cutting the ordinate axis in the common point $(0,T)$ and having slopes proportional to t_i with the proportionality factor $1/k_0$. In Fig. 1 we give for $t_i = 1{\cdot}0$, $1{\cdot}4$ and 7 days, respectively, the experimental mean induction times (in days) as found by Blum, Grady and Kirby-Smith, which are seen to cluster around three straight lines.

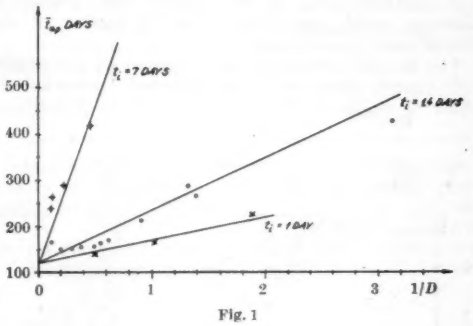

Fig. 1

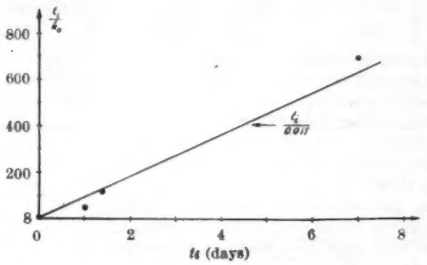

Fig. 2

In Fig. 2 we have plotted the slopes of these lines against t_i, and it is seen that they lie about a common straight line corresponding to $k_0 = 0{\cdot}011$. Thus the experimental findings of Blum, Grady and Kirby-Smith are in satisfactory agreement with our theory, and consequently they give new and independent evidence for the applicability of the quantum hit theory to the problem of the mechanism of carcinogenesis.

A detailed account of the application of the quantum hit theory to tumours induced by ultra-violet radiation, including the theoretical deduction

of the incidence versus induction time curves, will shortly be published (*Acta Path. et Microbiol. Scand.*).

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Niels Arley
University Institute for
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May 27.

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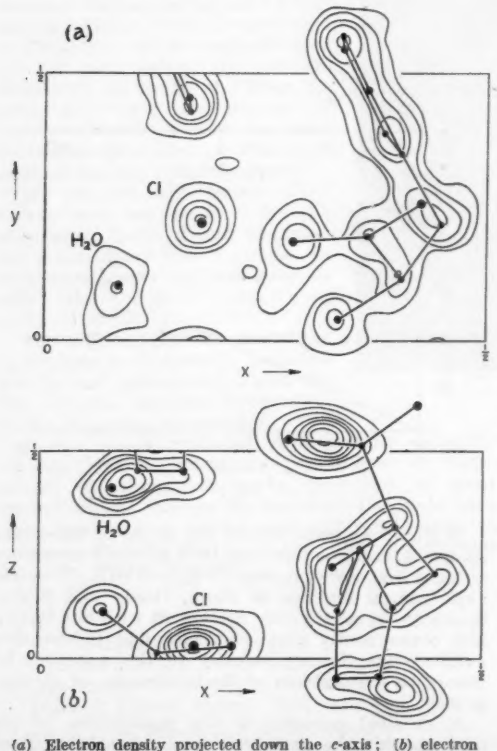
Crystal Structure of Histidine Hydrochloride Monohydrate

Crystals of the hydrochloride monohydrate of the important amino-acid histidine can be obtained as rather thick tablets by evaporation of aqueous solutions containing a little hydrochloric acid. X-ray examination shows that the crystals are orthorhombic, with unit cell edges $a = 15{\cdot}36$ A., $b = 8{\cdot}92$ A. and $c = 6{\cdot}88$ A. The space group is $P2_12_12_1$, and there are four molecules in the unit cell. The structure was obtained from a three-dimensional Patterson function which was interpreted by means of the vector convergence method[1].

The atomic parameters as indicated by the vector convergence diagram were adjusted somewhat in order to improve the agreement of the calculated interatomic vectors with observed Patterson peaks. The structure factors of the three prism zones were then calculated; the average discrepancy, R, for the 256 observed reflexions was 27 per cent. The structure factors of 170 of these reflexions were then treated by the method of least squares[2]. Shifts in the atomic parameters averaging 0·06 A. were obtained.



(*a*) Electron density projected down the *c*-axis; (*b*) electron density projected down the *b*-axis. Atomic positions, as obtained from the Patterson function, are shown by the solid circles

Plots of the electron density projected down the *c*- and *b*-axes were then prepared, by use of 89 of the 121 observed (*hk*0) reflexions and 57 of the 98 observed (*h*0*l*) reflexions respectively. The resulting maps are reproduced herewith. Contours were drawn at equal arbitrary intervals, except about the chlorine atoms, where they are drawn at half that interval. The atomic shifts suggested by these plots are in fairly good agreement with those obtained from the least-squares treatment.

From the degree of resolution in these projections it is doubtful whether the structure in three dimensions could have been obtained from them alone. On the other hand, once having determined the structure from the Patterson function, it is probable that a satisfactory refinement can be achieved without recourse to laborious three-dimensional Fourier and least-squares analyses, which involve complex structure factors.

The parameter refinement has been temporarily postponed, and since at the present stage of the work the standard error in a parameter is about 0 05 A., any discussion of the structure, such as which of the many tautomeric forms of the imidazole ring is present in the crystal, the precise dimensions of this heterocyclic ring, and the nature of the hydrogen bonding, must be deferred. At present, nevertheless, it is established that the histidine molecules in the crystal do not assume an extended configuration, but tend rather to curl back on themselves—a situation which may arise from significant attraction between the carboxyl group and the imidazole ring.

This work was carried out under Contract Nonr-220(05) with the Office of Naval Research.

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Oct. 30.

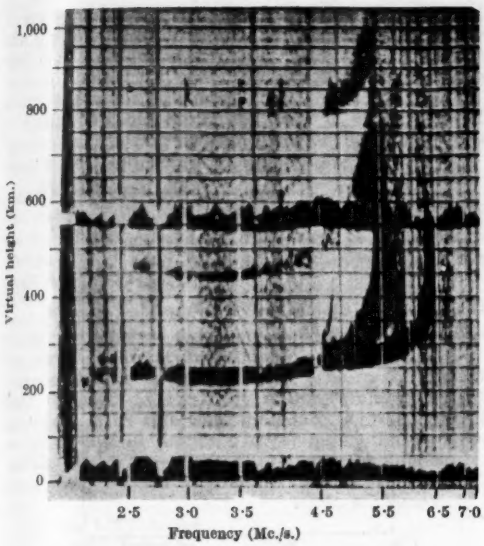
[1] Beevers, C. A., and Robertson, J. H., *Acta Cryst.*, **3**, 164 (1950).
[2] Hughes, E. W., *J. Amer. Chem. Soc.*, **63**, 1737 (1941).

Angle of Arrival of Z Echoes

It has been suggested by Scott[1] that uncoupled F-region Z echoes are due to longitudinally propagated waves reflected from an area near the magnetic zenith.

Measurements of the angle of arrival of Z echoes have recently been made at Hobart (geomagnetic latitude 51° S., dip 72°) in order to test this suggestion. The mean direction was found to be in the magnetic plane 7·8° north of the vertical. Thirty-four measurements were made between July 13 and August 3, 1952, on a frequency of 4·65 Mc./s. In all cases the Z echoes were observed during the late afternoon, the height of reflexion being between 170 km. and 210 km.

According to Scott's hypothesis, a collision frequency of about $1{\cdot}5 \times 10^5$ per sec. would be needed to explain the observed angle. This is inconsistent with previous estimates of collision frequency, which suggest that it is about 10^4 per sec. at 200 km.



I wish to thank the Electrical Engineering Department of the University of Tasmania for the provision of facilities and assistance in building the apparatus, and also the Radio Research Board of the Commonwealth Scientific and Industrial Research Organization for a grant in aid of the investigation.

G. R. Ellis

Commonwealth Observatory Ionospheric
Prediction Service,
Hobart, Tasmania.
Aug. 8.

[1] Scott, J. C. W., *J. Geophys. Res.*, **55**, 65 (1950).

Reflexion Coefficient of Radio Waves from Frozen Terrains

During the period January–February 1952, measurements were made in northern Canada in order to determine the reflexion coefficient of radio waves for normal incidence from deeply frozen land or sea. The frequency used was 1,600 Mc./s.

The method of measurement was to transmit a linearly polarized pulse signal vertically downwards from an aircraft flying at heights between 10,000 ft. and 20,000 ft. and to receive the signal re-radiated from the ground on a suitable receiver in the aircraft. Attenuation was inserted in the aerial lead of the receiver to maintain a constant received signal strength as the reflexion from the ground varied. The loop gain of the equipment was checked periodically to confirm that the performance of the equipment remained unchanged during the measurements. In addition, the signal was compared, whenever possible, with reflexions from open-water leads in Hudson Bay or the Great Lakes shortly before or after the measurements over the terrain in question. This was used as a standard for comparison.

It had been believed that the smallest reflexion coefficients likely to be met would not be lower than that from dry desert sand. This had already been checked over the shifting sand dunes of the Sinai Desert and also in desert areas in North Africa. The measurements agreed quite well with figures quoted previously by other authorities.

The reflexion coefficient from frozen muskeg and from the barren gravel areas north of the tree line in Canada was found to be roughly equal to that from dry sand. The frozen ice on Hudson Bay also gave a similar result. The ground temperatures were below − 35° F., and the ground and sea were frozen to a depth of several feet.

When flying over deeply frozen land where the land was heavily wooded, the land being covered with loose snow several feet deep and the trees thickly covered with snow and ice, a reflexion coefficient appreciably less than that from muskeg was observed. This was checked in two or three different areas, and the same figure was obtained on each occasion.

The figures of received signal power as compared with a sea reflexion were − 13 db. for sand, frozen muskeg or gravel, etc., and − 20 db. for frozen snow-covered forest. The accuracy of measurement was not worse than ± 2 db. The reflexion coefficient of sea water has been measured by other observers and is 0·83. Using this figure, the reflexion coefficients for various frozen terrains have been calculated and are as follows:

Terrain	Reflexion coefficient
Sea	0·83
Deep ice on sea	0·20
Frozen muskeg or barren gravel	0·20 to 0·25
Frozen lakes	0·25
Frozen snow-covered forest	0·08

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this communication.

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Royal Aircraft Establishment,
Farnborough, Hants.
Sept. 2.

Light Scattering by very Stiff Chain Molecules

Very precise light-scattering measurements by B. H. Bunce[1] on several thymonucleic acid preparations have shown that the scattering function of these gigantic macromolecules—the molecular weights are between 2·6 and 6·7 millions—differ remarkably from that of a random coil. The angular dependence of the reciprocal reduced intensity $1/P = I(0)/I(\vartheta)$, for all samples, reveals that the molecules are not perfectly coiled. The experimental points are situated between the curves for a random coil and that for a stiff rod.

Therefore it seemed worth while to compute the scattering function for a thread-like molecule of finite length with variable flexibility. In some previous work on viscosity and sedimentation[2] of such relatively short molecules, the usual 'pearl-necklace' model was chosen. By variation of the valency angle $\alpha = 180° - \beta$ between two consecutive links and the length of link b, all kinds of flexibility from the stiff rod ($\cos \beta = 1$), to the quite soft thread ($\cos \beta = 0$), can be represented. This model is not very suitable for the consideration of light scattering; it can be replaced by the 'thread' model with continuous mass distribution and curvature introduced by Kratky and Porod[3] in the theory of X-ray scattering.

The measure of the flexibility is the persistence length a, the average value of the projection of an infinitely long thread on the tangent at one end of the thread : $a = b/(1 - \cos\beta)$.

This model fits much better the conditions for the scattering of visible light than for X-rays, as the fine structure of the macro-molecule, that is, the linking of the monomers, does not matter compared to the wave-length of some 1000 A.

According to Kratky and Porod, two thread elements, dl_1 and dl_2, separated by the length l_{12} of the chain, on the average give rise to a scattered intensity proportional to

$$\exp - k^2 s^2 R^2_{12}/6,$$

where $k = 2\pi n/\lambda$, $s = 2\sin\vartheta/2$, $R^2_{12} = 2a^2(x_{12} - 1 + \exp - x_{12})$, $x_{12} = l_{12}/a$, provided the distribution-function of their mutual distance r_{12} does not differ too much from the Maxwellian. This does not apply to the stiff rod, $x = 0$, and is also a bad approximation for small values of $x \sim 1$, but gets rapidly better with increasing x.

With this simplification, the scattering function for the molecule reads :

$$P(\vartheta) = \frac{1}{L^2}\int_0^L\int_0^L \exp(-k^2s^2R^2_{12}/6)\,dl_1\,dl_2 =$$

$$\exp p\left[F(p,x) - \frac{p}{1!}F(p+1,x) + \frac{p^2}{2!}F(p+2,x)\ldots\right],\ x \gg 1,$$

with

$$F(p,x) = \frac{2}{(px)^2}(px - 1 + \exp - px)\quad p = k^2s^2a^2/3.$$

The accompanying graph shows $1/P(\vartheta)$ for various values of x, where the variable

$$v = 3p\left[\frac{x}{3} + F(1,x) - 1\right] = A(a,x)\ .\ \sin^2\frac{\vartheta}{2}$$

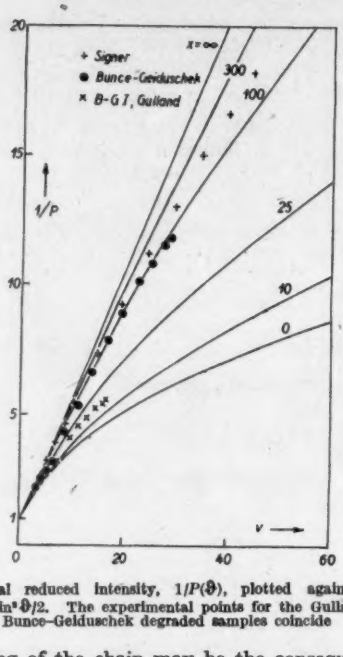
is chosen in such a way that the initial slope is the same for all curves. The curve $x = 0$ is the known scattering function for rods. Even at very large values of x, the limiting curve $x = \infty$ is not reached. In fact, the deviations are quite noticeable at as large a value as $x = 300$.

The experimental data of Bunce on various samples fit into this picture very well. The following dimensions may be deduced :

Sample	M	x	a	L	R	M/L
Present writer	$6{\cdot}7\times10^6$	150	287 A.	43,000 A.	4950 A.	156 M.U./A.
Bunce–Gelduschek	4·0	100	263	26,300	3750	152
Bunce–Gelduschek degraded*	2·64	16	541	8700	2970	305
Gulland	4·0	16	541	8700	2970	462

* The sample had been left for 20 hr. in an acid solution of pH 3·0.

In the first two samples, the structure of the thymonucleic molecule seems to be very similar, the persistence length a being markedly the same in both. The last two samples also agree completely with each other in their geometrical dimensions. The large value of a signifies that the coil is twice as extended. The overall length, however, is much smaller than that of the first two samples. Hence, the mass density M/L is increased to 305 and 462 M.U./A. The



Reciprocal reduced intensity, $1/P(\vartheta)$, plotted against $v = A(a,x)\cdot\sin^2\vartheta/2$. The experimental points for the Gulland and Bunce–Gelduschek degraded samples coincide

shortening of the chain may be the consequence of an internal association of neighbouring chain segments. The additional linkages coupled with the increased density evidently stiffen the molecule and yield a more extended coil. Very careful preparation may prevent such an internal association, which takes place also on degradation in acid solutions.

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"J. Stefan" Institute of Physics,
Ljubljana. June 5.

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'Newtonian' Time in General Relativity

A result recently given by Eisenhart[1] suggests an interesting application in general relativity. According to it, we can choose co-ordinates in which a line element showing spherical symmetry would take the form :

$$ds^2 = -r^2(d\theta^2 + \sin^2\theta d\varphi^2) + \gamma dt^2 + 2adrdt,\quad \gamma = \gamma(r,t),\quad a = a(r,t) \qquad (1)$$

and a radial null vector w^μ will have $w^2 = w^3 = w^4 = 0$, so that the velocity of light along radial directions (given by w^1/w^4) is infinite. Hence we may call the co-ordinates (r,t) the 'Newtonian' co-ordinates.

Several well-known solutions in general relativity take up very simple forms when expressed in these co-ordinates. Schwarzschild's exterior solution has :

$$a = 1,\quad \gamma = 1 - 2m/r. \qquad (2)$$

Here m is the constant giving the mass of the particle at the origin. If, however, we take m to be an arb-

itrary function of t, the same solution will represent the gravitational field of a radiating star found by us[2], thus showing that our solution of a non-static mass is the natural generalization of Schwarzschild's solution for a static mass.

Again, for describing the field of a mixture of matter and flowing radiation within the interior of a star, where the energy tensor is of the form[3]:

$$T_{\mu\nu} = (p + \rho)v_\mu v_\nu - pg_{\mu\nu} + \sigma w_\mu w_\nu, \quad v_\mu v^\mu = 1, \quad w_\mu w^\mu = 0, \quad (3)$$

we can choose co-moving Newtonian co-ordinates in which $v^1 = v^2 = v^3 = 0$, $w^2 = w^3 = w^4 = 0$. We shall then find that:

$$T_1^1 = T_2^2 = T_3^3 = -p; \quad T_4^4 = \rho. \quad (4)$$

These relations are the same as the familiar relations for static solutions. Of course, here, $T_1^4 \neq 0$.

Recently, we have found that even in the unified field theories described by a non-symmetrical g_{ik}, co-ordinates of this type introduce a great deal of simplification in problems involving radiation flow. Details of this investigation are awaiting publication elsewhere.

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Serological Relationships of Hyrax and Elephant

ORIGINALLY classed with the Pachyderma, the hyraxes (rock rabbits or conies) have in turn been placed in the orders Rodentia and Perissodactyla. More recently, they have been placed in a separate order, the Hyracoidea[1]. It is, however, still open to discussion whether there is not a relation between hyrax and elephant; one of the more recent contributions on the subject is based on the similarity of the placental formation in animals of the two orders concerned[2].

In the course of some recent work on the development of the use of precipitating antisera for the identification of blood meals of tsetse flies and other African blood-sucking arthropods, an antigenic relationship between elephant and hyrax has been observed. Serological relationships have been noted by various workers between related animals of many different species since the original work of Nuttall[3] on this subject. Qualitative determinations made by the ring test have been shown to be valid, providing the antisera used in the reaction are devoid of non-specific antibodies. Before absorption, antisera prepared in rabbits by repeated injections of alum-precipitated serum give reactions at a high titre with the serum of all the mammals which were tested and which included representative samples from most orders[4].

Two antisera were prepared in rabbits by the repeated injections of alum-precipitated sera of the Indian elephant (*Elephas elephas*) and hyrax (*Heterohyrax syriacus prittwitzi* Brauer) respectively, and both antisera gave positive reactions at high titre with the sera of all mammals which were tested. Each antiserum was then absorbed with the sera of man, ox, sheep, horse, pig, dog and cat in the proportions necessary to remove the corresponding antibodies. These absorbed antisera were then re-tested as before with the sera of a wide range of species of mammals and were found to react only with elephant and hyrax in both cases. The anti-elephant serum reacted at a titre of 1 : 64,000 with elephant serum and at 1 : 32,000 with hyrax serum, while the anti-hyrax serum reacted at a titre of 1 : 16,000 with hyrax serum and at 1 : 8,000 with elephant serum.

These observations, which were similar to those previously made with known related mammals, indicate a very marked relationship between the sera of hyrax and elephant; they are also of interest in relation to the taxonomic position of the Hyracoidea.

I am grateful to the Zoological Society of London for supplying the elephant serum, and to T. C. S. Morrison Scott for identifying the species of hyrax.

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Assessment of Consciousness during Curarization

MODERN surgical techniques and experimental methods make increasing use of muscular relaxants combined with anæsthetics to produce the optimum conditions for surgery. This practice leads to certain difficulties in assessing consciousness, since the usual muscle reflexes are impaired by the action of the relaxant. The change in heart-rate in response to a pain stimulus has recently been investigated and found to be a reliable indicator of consciousness during electrical curarization in animals, and during ether anæsthesia in man[1]. It therefore seemed possible that this cardiac pain reflex might be useful as an index of consciousness when muscular relaxants were being used.

'Flaxedil' was injected intravenously into rabbits so that the voluntary muscles were paralysed, and the heart-rate was recorded continuously on one channel of an electro-encephalograph machine; the pain stimulus consisted of a pin-prick on the nose of the animal. This stimulus resulted in an increase in the heart-rate which varied from 9 to 14 per cent with different individuals and lasted for about thirty seconds; the cardiac pain reflex before injection was similar in size and duration, but during light anæsthesia it was reduced, and in surgical anæsthesia it was abolished.

The pupillary reflex to light, which can sometimes be used when voluntary muscle is paralysed, is not easy to observe after injection of 'Flaxedil' because ptosis and nystagmus occur. If a suitable heart-rate indicator is available, or could be designed, it might now have considerable practical application in human and veterinary surgery when curarizing drugs or new anæsthetics are being used.

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Chromosomal Re-arrangements in the Progeny of *Drosophila* Males treated with Mustard Gas

When *Drosophila* males are treated with mustard gas, the proportion of chromosome re-arrangements to sex-linked lethals in their progeny is lower than after an X-ray treatment which yields the same frequency of sex-linked lethals. This observation has been made by genetical methods[1]. It has been confirmed by the cytological findings of Slizynska and Slizynski[2], who examined the salivary chromosomes of strains carrying sex-linked lethals induced by mustard gas and reported that these chromosomes had many fewer structural changes than would have been expected if the lethals had been induced by X-rays. Since these investigations were based on selected samples of chromosomes—namely, *X*-chromosomes already shown to carry a lethal—it seemed important to check them on unselected samples. Accordingly, wild-type *Drosophila* males were given different doses of mustard gas, and unselected female F_1 larvæ were analysed for chromosomal changes in their salivary glands. The apparatus for the treatment was designed by Dr. H. Moser and has been described elsewhere[3]. The genetical effectiveness of each dose was measured in terms of sex-linked lethals. For comparison, exposures were carried out with doses of X-rays which approximately matched those of the mustard gas in respect of their ability to produce sex-linked lethals. The results are summarized in the accompanying table.

The observations bear out the previous genetical and cytological findings. In the overall result, as well as at each dosage-level, there is a marked shortage of re-arrangements in the mustard-gas series as compared with the X-ray one. The overall difference between 7·6 per cent re-arrangements in the X-ray series and 1·3 per cent in the mustard gas series is significant at the 0·1 per cent level. The results are not sufficient to decide whether, as the table suggests, the ratio between the two frequencies tends to shift in favour of irradiation as the dose is increased. If this should be true, it would indicate a difference in the mechanisms by which these two mutagenic agencies produce re-arrangements. Experiments to test this point are under way in this department.

A point worth noting is the occurrence of two reversed repeats among the eleven chemically induced structural changes. No repeat occurred among the forty-eight radiation-induced changes; in general, repeats appear to be rare after radiation treatment. The occurrence of two of them in a very small sample of chemically induced changes is remarkable. It is, however, in line with the observation made by Auerbach[4] that a high proportion of visible mutations induced by mustard gas occur first as mosaics in the progeny of treated males; for repeats, like mosaics, are changes which must have arisen after the treated chromosome had separated into its daughter chromatids.

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Frequency of Large Chromosome Re-arrangements after Different Doses of X-Rays and of Mustard Gas

Expt.	X-rays						Mustard gas					
	% sex-linked lethals	No. larvæ examined	No re-arrangements between chromosomes	No re-arrangements within chromosomes	total No.	total %	% sex-linked lethals	No. larvæ examined	No. re-arrangements between chromosomes	No. re-arrangements within chromosomes	total No.	total %
I	3·2 ± 0·7	172	1	1	2	1·1	3·7 ± 0·6	195	0	0	0	0
II	4·6 ± 0·9	162	4	7	11	6·8	4·1 ± 0·8	234	4	1	5	2·1
III	8·0 ± 1·2	137	5	2	7	5·1	7·1 ± 1·1	216	0	1	1	0·5
IV	10·4 ± 1·3	165	13	15	28	16·9	15·0 ± 4·0	177	0	5	5	2·8
		636	23	25	48	7·6		822	4	7	11	1·3

Chemical Constitution of the *L*-Forms of Bacteria

The *L*-forms of bacteria, a study of which has been described recently[1], are dwarf organisms derived from a complex transformation of bacteria, either spontaneously or under various noxious influences. Their morphological as well as biological characters are so different from those existing in the bacteria they are derived from that it seemed interesting to us to compare the chemical constitution of these two forms of the same organism.

The material used for our chemical study was *L*-forms of *Proteus* (*P* 18), three to four weeks old, grown on a liquid medium[2]. The *L*-forms are separated from the medium by centrifugation, washed twice in physiological serum, then in distilled water, concentrated by centrifugation at 12,000 r.p.m. and resuspended in distilled water. It is emphasized that this material is not absolutely homogeneous. It consists of a mixture of about 80 per cent of *L*-forms and 20 per cent of various stages in the evolutionary cycle of these forms. We have not been able, so far, to get rid of these intermediate forms; nevertheless, we do not think that this would affect seriously the relative value of our results.

The comparative estimation of nitrogen and phosphorus shows that the nitrogen content is higher in the normal *Proteus* than in the *L*-forms, while the phosphorus content, on the contrary, is lower.

Treatment of the *L*-forms with cold 5 per cent trichloracetic acid gives an acid-soluble fraction, the total nitrogen of which represents about 6 per cent of the total nitrogen of the micro elements, and the phosphorus 55 per cent of the total phosphorus; under the same conditions, the normal *Proteus* loses about 8·5 per cent of its total nitrogen, but only 22 per cent of its phosphorus. This demonstrates in the *L*-forms an accumulation of small molecules of phosphorus compounds.

Treatment with boiling alcohol for 1 hr. and with boiling ether for 30 min. allows the extraction of

COMPARATIVE ANALYSIS OF NORMAL *Proteus* AND OF THEIR *L*-FORMS (per 100 parts dry weight)

	Total N	Total P	$\frac{N}{P}$	Total lipids	Total proteins	Total nucleic acid	DNA	RNA	$\frac{RNA}{DNA}$
Normal *Proteus*	14·77	2·45	6·60	6·0	73·0	11·59	3·28	8·31	2·50
L-forms	10·27	2·88	0·36	24·3	58·9	1·65	1·45	0·20	0·14

24·3 mgm. lipids per 100 mgm. of dry weight. The quantitative importance of this lipidic fraction should be noted. It is much more important than that which can be extracted from normal *Proteus* (for example, 4–8 per cent). The lipidic fraction contains 2·16 per cent phosphorus.

Analysis of the nucleic acids[3] in the *L*-forms free from lipids and the acid-soluble fraction shows clearly an amount of deoxyribonucleic acid (1·45 per cent of the dry weight of the initial material) greater than that of ribonucleic acid (0·20 per cent). The ratio of ribonucleic to deoxyribonucleic acid is thus, for the *L*-forms, just the reverse of that found in normal bacteria. The amount of ribonucleic acid in ordinary bacteria, even in the lag phase (that is, at the time when ribonucleic acid is at its lowest), is generally equal to, or greater than, the amount of deoxyribonucleic acid.

A summary of our results is given in the accompanying table.

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Contamination of Nectar with the Systemic Insecticide 'Schradan'

RIPPER *et al.*[1] have shown that the organophosphorus insecticide, octamethylpyrophosphoramide ('Schradan'), when sprayed on leaves, is absorbed and translocated to other parts of the plant. Metcalf and March[2] have demonstrated the tolerance to 'Schradan' shown by the honey bee. Using radioactive 'Schradan', containing phosphorus-32, we have examined the possibility of the unchanged insecticide being present in the nectar of flowers and afterwards appearing in honey.

The leaves of white mustard plants (*Sinapis alba*) were sprayed during July 1952 with an aqueous solution of radioactive 'Schradan' (about 0·75 μC. per ml.) also containing radioinactive 'Schradan' (0·16 per cent) and a wetter. A total of 4 ml. per plant was applied in five applications over five days. The plants when treated were approximately 1 ft. in height and had doubled their size by the end of the experiment (five weeks). All flowers open on the last day of spraying and on the following day were removed, to obviate the possibility of direct contamination of nectar by the spray. Flowers that opened three to twelve days after the completion of the spraying were used as the source of a bulk sample of nectar for assessment of 'Schradan' content. After chloroform fractionation, as recommended by Ripper *et al.*[1], radio-assay indicated a concentration of 5·5 p.p.m. of unchanged 'Schradan' in the nectar. Nectar collected over later periods showed lower contents of the unchanged insecticide.

Another test made with borage (*Borago officinalis*) confirmed that unchanged 'Schradan' could occur in nectar. In this plant the comparable value was 2·5 p.p.m.

Other work has shown that 'Schradan' is not decomposed while in the honey stomach of the bee or in honey during a storage period of ten weeks.

Full details of this work are being published elsewhere.

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Transmission of Hop Mosaic by *Phorodon humuli* (Schrank)

MOSAIC disease of hops was first described by Salmon[1]. Later Thrupp[2], and Salmon and Ware[3], showed it to be transmissible by grafting. This was followed by the extensive studies of Mackenzie *et al.*[4], who showed that some commercial varieties were symptomless carriers. Growers' observations of spread from carrier varieties to adjacent susceptible hops were confirmed by Keyworth[5].

It was suspected that insects were responsible for the spread of mosaic, and in 1948 an extensive experiment was carried out to test the ability of the hop–damson aphid, *Phorodon humuli* (Schrank), to transmit the virus. Eggs of this aphid, laid on *Prunus* spp. in the autumn, hatch in early spring and, after several wingless generations, winged forms develop which migrate to hop. There follows a succession of asexual wingless generations throughout the summer. Another winged generation occurs which returns to *Prunus* and produces wingless sexual females. These are fertilized by winged males which develop to maturity on hops and then migrate to *Prunus*. 3,520 summer wingless *P. humuli* were tested as vectors with short and long feeding periods, using eight different sources of hop mosaic as infectors, but there was no transmission to the 128 indicator plants.

Work was therefore started to find other insects that might be suspected of transmitting hop mosaic. A survey of the insects occurring on hops was made by Paine[6], and an experiment designed to determine the period during which mosaic spreads. Monthly collections of insects were made at five gardens in which mosaic was known to be spreading. Thirty-five species were recorded in one year and twenty-three in the next; only six species were found in both years. As mosaic had spread in both years it was

inferred that one or more of these six species might have been involved in its transmission.

All the insects that had been collected in one hour from a hundred plants each month were allowed to feed on mosaic-infected hops and then transferred to ninety test hop plants (Bramlings), each of which received one or more species. Four of these plants developed mosaic within one year; and the only species which all four had received was the spring winged form of *P. humuli*.

To find out the period during which mosaic spreads, ten plants of a susceptible variety (Petham Golding) were placed in a garden of a carrier variety (Brewers Gold) each month from March to August. Each batch of these indicator hop plants was stored at 0° C. and then grown for one month in an insect-proof glasshouse; the potted plants were then exposed in the field of infected hops for one month and then returned to the glasshouse for observation. Two of the plants exposed in June and one exposed in July later developed mosaic.

The facts—(1) that the spring winged form of *P. humuli* had occurred in both years collections; (2) that four plants developed mosaic after treatment with this form of the aphid; (3) the spread of this disease had occurred during the later period of the spring winged generation flight—suggested that this aphid should be retested as a vector of mosaic, using the spring winged generation.

In 1951 Petham Golding hops were infested with winged *P. humuli* collected from hedgerow *Prunus* species. Each of the ten test plants received some aphids direct from the *Prunus* and others which were first fed on mosaic-infected hops for 1 hr.–30 days. Nine of the ten test plants developed a line pattern symptom later in the same year, and early in 1952 six of these test plants developed vein banding and downward leaf curling for a short period and then apparently recovered. Since then, four of the test plants have developed mosaic symptoms, including the plant that did not show line pattern in 1951. No symptoms have developed on any of the controls.

No other case is known where one form of an aphid is able to transmit a virus while another form of the same species is not, and further investigations are being made to elucidate this phenomenon. Work is also being continued to determine the relationship between viruses occurring in *Prunus* species and those found in the hop.

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Spermatogenesis in *Lumbricus terrestris* L., Müll.

While the histology of spermatogenesis s.str., that is, the maturation of the spermatids to form ripe spermatozoa in *Lumbricus terrestris* L., is known in detail, explanations of the orientation of the developing spermatid remain somewhat obscure. The only complete and easily available information is contained in the general text-book of Borradaile[1], where diagrams show the 'tail' of the sperm arising at the cytoplasmic vesicle at the periphery of the morula and remaining in this position during its subsequent elongation away from the cytophore. The cytoplasmic vesicle and the cytophore are shown in Fig. 1 (*c.v.*, *cph.*). The account of Hesse[2] interprets the orientation of the spermatid in the same way as Borradaile, stating that the acrosome or 'head' end arises from the cytoplasmic pedicle which is directed towards the centre of the morula (Fig. 1, *c.p.*). Depdolla[3], however, explains the orientation in the reverse way and regards the cytoplasmic vesicle as representing the acrosome or 'head' end of the sperm, and states that the 'tail' develops from the cytoplasmic pedicle. More recent work by Chatton and Tuzet[4], who made a very detailed histological examination, confirms this view, though no figures are given in their work of the final relationship of the ripe spermatozoa to the cytophore.

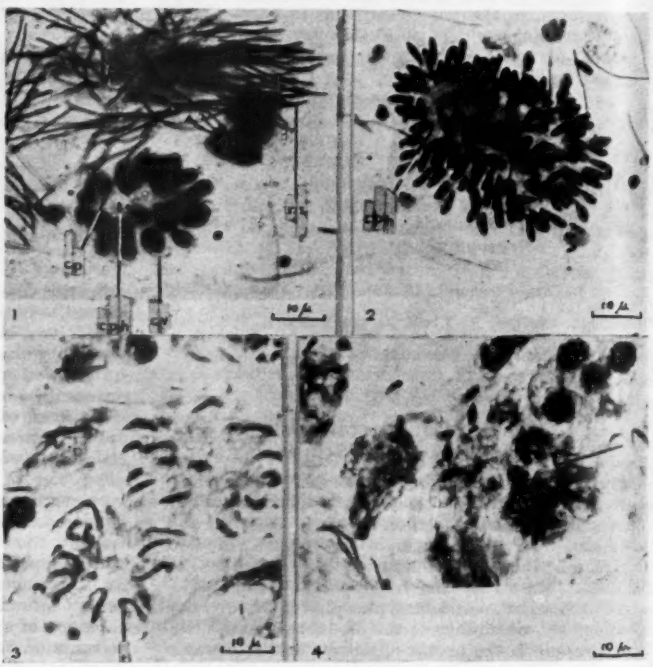

Fig. 1. Early stage in spermatogenesis of *Lumbricus terrestris*
Fig. 2. Later stage in spermatogenesis of *Lumbricus terrestris*
Figs. 3 and 4. Successive stages in spermatogenesis of *Fasciola hepatica*, showing origin of 'tail' region next the cytophore
c.p., Cytoplasmic pedicle; *cph.*, cytophore; *c.v.*, cytoplasmic vesicle; *r.s.*, ripe sperm; *t*, tail

Fig. 2 shows the elongating nuclei of the spermatids, with the broad ends which were nearest the cyto-

plasmic vesicle towards the outside and the pointed ends directed inwards towards the cytophore (Fig. 2, *cph.*). If this orientation persists throughout maturation it follows, on the basis of the interpretation of Chatton and Tuzet, that the ripe spermatozoa of *Lumbricus* adhere to the cytophore by the tips of their 'tail' ends, which is the reverse of what the Borradaile diagram shows, and the reverse of that observed by me on living unstained material. Whitehouse and Grove[5] confirm the latter observation and state that in most stained smears only the 'head' of the sperm stains, and that is attached to the cytophore (Fig. 1, *r.s.*).

Accordingly, I suggest that there may be a reversal of orientation of the spermatid between the stage shown in Fig. 2 and the final stage. As a result of investigating spermatogenesis in the trematode, *Fasciola hepatica* L., and in the cestode, *Eubothrium crassum* (Bloch), it appears that there is some evidence to support this view (assuming the basic process to bear some similarity in the Platyhelminthes and Annelida). In both the Platyhelminthes there is, as in *Lumbricus*, a similar outpushing of the wide end of the elongating spermatid nucleus at the cytoplasmic vesicle, while the inwardly directed, pointed end of the nucleus coils and appears to form the 'tail' of the sperm, moving towards the periphery at the same time (Figs. 3 and 4, *t.*). Wilmott[6], working on the trematode *Gigantocotyle bathycotyle* Nasmark, figures a stage very similar to that observed by me, though she makes no comment upon orientation. Observation of this stage is made easier in the Platyhelminthes because, first, the development concerns only the nucleus—it is doubtful if any cytoplasm enters into the final composition of the ripe spermatozoa in this group—and, secondly, the cytophore is here formed sooner and is relatively more extensive, making the change in orientation more plainly visible and possibly causing the process to slow down. Unfortunately, in the Platyhelminthes the ripe spermatozoa do not adhere for long, if at all, to the cytophore, so that there is no stage visible which corresponds with the final stage in *Lumbricus terrestris*. However, it seems very possible that the mobility of the 'tail', together with its elongation, coiling and subsequent uncoiling, would cause the 'tail' to be thrown free of the cytophore before the 'head' end.

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Change in the Composition of the Bottom Fauna of the Dogger Bank Area

UNDER the above title, Erik Ursin[1] reports certain differences between the bottom fauna found by him during 1950–51, and its composition as reported by F. M. Davis[2] during 1921–23. I am able to confirm most of these differences, because part of my work took me to the same area, and at the same time, as Ursin. But I think that caution is needed in assuming that the differences are due to real changes in the bottom fauna. It will be remembered that Davis thought that the spatfalls of molluscs are likely to be local and uncertain, and his 'soil-current' theory is an enunciation of this belief. The substitution of *Ensis ensis* and *Tellina fabula*, during 1950–51, for *Spisula subtruncata* and *Mactra corallina* as the dominant lamellibranchs, lends support to Davis's theory. But Davis worked with a Petersen grab, and Ursin and I are both using van Veens, and since the latter is probably more efficient at digging in sand than the former[3], it is likely that these differences in fauna are at least partly the results of changed gear. There is much need for a thorough comparison of the two instruments.

It is also important to remember that the comparisons were made between an October cruise of 1921 and a spring survey during 1950–51, and that important spatfalls are likely to occur in the summer, which, if all the molluscs should disappear before spring of the following year, will not yield results similar to those of a spring survey. In fact, I have just (October 31–November 4) surveyed the west Dogger Bank again. I discovered the presence of many hundreds of 1–1·5 cm. *Mactra corallina* in a large patch, roughly twenty miles north-north-east of where Davis discovered the same species to predominate. I have always found enormous numbers of freshly coloured large (2–3 cm.) empty shells of *M. corallina* in this area; but the living ones had up to now escaped me, presumably because of the timing of the surveys. In November there were 2,775 *Mactra* per m.[2] at the greatest density.

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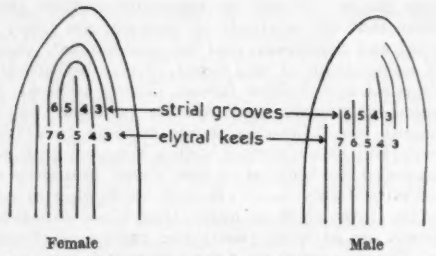
A Simple Method for Sexing the Confused Flour Beetle

THE sub-basal pit, on the front femora of males of several species of *Tribolium*[1], is very difficult to observe in *T. confusum* Duv., and its use in sexing large numbers of the beetles is not practical.

I have now found that *T. confusum* can be much more conveniently sexed by examination of the elytral declivity, where the keels and strial grooves form a pattern characteristic of the sex (see accompanying diagram). In the female the keels on the seventh and third intervals are united distally, as are those on the sixth and fourth. The keels may be, in part, absent or reduced to slight ridges; but the sixth strial groove is always clearly distinguishable up to its junction with the third. In addition, the apical area of the elytron beyond the keels does not have a distended appearance and has punctures approximately the same size as those on the striæ. In the male the keels on the seventh and third intervals are never united distally, and the sixth strial groove is never continuous with the third. The apical area beyond the keels has a distended appearance and has punctures coarser than those on the striæ. Most individuals could be sexed with certainty by examination of one elytron, under a binocular microscope (× 15); but in a doubtful case the other elytron should be examined. In a test of the method more than two thousand beetles were correctly sexed. Dead desiccated beetles or anæsthetized living beetles



Tribolium confusum Duv. Dorso-lateral view of apical halves of right elytra of female and male

can be equally easily sexed, and with practice can be examined at the rate of 400–500 per hour.

T. destructor Uyttenb. can be readily sexed on similar elytral characters. Reliable results can also be obtained with *T. castaneum* Herbst; but the characters are much less obvious and considerable practice is necessary.

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Urea Complexes of Rape-oil Fatty Acids

In the course of investigations on the catalytic autoxidation of highly purified brassidic acid (*trans* docos-13-enoic acid), methods for the isolation of erucic acid, the *cis* isomer, have been examined.

The source of this acid has been the mixed fatty acids from the saponification of rape-oil which, in addition to about 50 per cent erucic acid, contain quantities of oleic acid and smaller amounts of linoleic and C_{16}–C_{24} even-numbered saturated acids.

Schlenk and Holman[1] have prepared urea complexes of a number of higher saturated and unsaturated fatty acids by treatment with urea in methanol solution. These workers have shown that complex yields increase with molecular weight of the acid but decrease with unsaturation. The yields from linoleic acids were found to be zero under the conditions used. From the methyl esters of mixed olive-oil fatty acids, these workers isolated highly purified methyl oleate by a urea-complex methyl ester fractionation technique, and it appeared that a similar method could be applied to the mixed fatty acids of rape-oil.

In a preliminary experiment, 4 gm. of mixed fatty acids (iodine value 100) were treated with 15 gm. urea in 100 ml. methanol. On warming to dissolve and cooling, 14 gm. of needle-shaped crystals of the complex were deposited, which, on warming with water, yielded a white solid acid (iodine value, 68·3). It appeared that separation from unsaturated fatty acids had been effected, the solid acid consisting of erucic acid (iodine value, 75) and saturated fatty acids. A large-scale separation of the mixed fatty acids was then attempted by addition of urea in sufficient successive quantities to separate saturated acids, erucic acid, and lower monoethenoid and polyethenoid acids. 140 gm. mixed fatty acids yielded 94 gm. erucic acid concentrate (iodine value, 76·1; acid value, 171). Difficulty was experienced in completely removing saturated acids by this method, since urea-complex yields of erucic and saturated stearic, arachidic and behenic acids are similar, and a final purification of the acid was effected by a lead salting method.

Urea complex fractionation appears to be advantageous for a preliminary separation of mixed rape-oil fatty acids during the preparation of erucic acid. The complete one-stage elimination of polyethenoid acids from the product is achieved. According to Hilditch[2], this is essential when the purified acid is used for investigations into the mechanism of autoxidation of monoethenoid unsaturated fatty acids.

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Influence of Trypan Blue on the Number of Circulating Eosinophils in Rats

Gordon and Katah[1] suggested that the adrenal cortex exerts a regulatory influence upon the function of the macrophagic system. Selye[2] observed an increase of the phagocytic activity of the reticulo-endothelial system in the alarm reaction.

In the present study, an attempt has been made to determine whether the eosinopœnic response in stress is influenced by the functional state of the reticulo-endothelial system. It has been observed recently that the functional depression which follows the 'blocking' of the reticulo-endothelial system is of short duration[3]. In my experiments, 'blocking' was produced by repeated injections of trypan blue.

Young male white rats weighing about 100 gm. were used. Stress was produced by the subcutaneous administration of adrenaline (Upjohn) in doses of 0·05 mgm./100 gm. body-weight. Eosinophil counts were carried out by the method of Speirs and Meyer[4]. One group of rats received intraperitoneally, on two subsequent days, a solution of 1 per cent trypan blue in saline (dose, 1 ml./100 gm. body-weight). Another group received on the first day the same amount of an isotonic solution of sodium chloride, on the second day trypan blue. The third, control, group received the solution of sodium chloride on both days. Eosinophil counts were performed in all the groups 20 hr. after the second injection. Epinephrine was then administered and eosinophil counts repeated 3 hr. later. The results are summarized in the accompanying table.

It is obvious that the injection of trypan blue is followed by a significant ($P < 0.001$) increase of the number of circulating eosinophils, whereas the

Effect of Trypan Blue and Adrenaline on the Number of Circulating Eosinophils in Rats

No. of animals	Treatment	Eosinophils in 1 c.mm.	Fall in eosinophil count following adrenaline (% of initial value)
35	Sodium chloride	290± 8·14*	29·40±8·47
24	Sodium chloride + trypan blue	432±24·78	46·16±5·58
12	Trypan blue	606±73·05	70·50±3·78

* Standard error of the mean.

response to adrenaline stress is not abolished. It seems, therefore, that although the 'block' produces an increase of circulating eosinophils, the functional state of the reticulo-endothelial system has no influence on the eosinopænic response observed in stress.

Detailed hæmatological and bone-marrow studies of rats treated with trypan blue will be published elsewhere.

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Extraction of Acetylcholine from Brain Tissue

IN some recent attempts[1] to follow rapid changes in the concentration of acetylcholine in mammalian brain *in vivo*, the experimental animals were killed by freezing in liquid air, a method which had already yielded valuable results when applied to the study of certain other labile metabolites[2]. As an accompaniment to these studies, one of us[3] reported that the amount of acetylcholine which can be extracted from excised brain frozen in liquid air is some 13 per cent greater than when it is extracted from unfrozen tissue by the more usual methods. Since this work was completed, however, Elliott and his colleagues[4,5] have claimed that a complete extraction can be achieved only by homogenizing the unfrozen brain in an acid saline solution; according to these workers, previous freezing of the excised tissue results in a loss of up to 50 per cent of its contained acetylcholine. It has, however, proved impossible to confirm these findings, as the following experimental results testify.

Acetylcholine was extracted from the excised brains of adult rats, using the method described by Elliott *et al.*[4], except that the extracts were assayed in the frog rectus muscle. While histological examination showed that the homogenization had been efficiently carried out, the amount of acetylcholine extracted corresponded to a brain concentration of only $1{\cdot}69 \pm$ S.E. $0{\cdot}12$ μgm. per gm. (ten animals). A second series of brains was extracted by a similar method, using a bladed homogenizer (10,000 r.p.m.), and was found to contain $1{\cdot}73 \pm$ S.E. $0{\cdot}03$ μgm. acetylcholine per gm. (four animals). These figures are very much lower than those reported by Elliott and his co-workers, namely, $3{\cdot}45$ μgm. per gm., and are similar to those usually quoted for excised tissue. It seems possible that the leech muscle used by the Canadian workers was affected by sensitizing substances. MacIntosh[6] found that saline extracts of mouse brain do exert a sensitizing effect on the leech preparation, though Elliott and his colleagues[4] deny that their extracts had a similar effect. Tobias and his co-workers[7] used an extraction technique similar to that of Elliott *et al.* but assayed their preparations on the frog rectus muscle, which is known to be very susceptible to the effects of sensitizing substances in brain extracts. Though they failed to eliminate the effects of these agents and must therefore have obtained an exaggerated estimate of the amount of acetylcholine present in their extracts, their results are very similar to those quoted by Elliott *et al.* In the present experiments, it was found that, for saline extracts of brain, an acetylcholine assay of $1{\cdot}8$ μgm. per gm. rose to $2{\cdot}9$ μgm. per gm. (mean of six experiments) when the effect of the sensitizing substances was not controlled, though the rectus muscles were very sensitive and had been treated with optimal amounts of neostigmine.

In other experiments, excised brain tissue was divided into two equal portions, one of which was homogenized in acidified saline solution, while the other, after freezing in liquid air, was powdered and its acetylcholine extracted by contact with aqueous trichloroacetic acid for twenty minutes. The homogenized brain was found to contain $1{\cdot}38 \pm 0{\cdot}03$ μgm. acetylcholine per gm., the frozen brain $1{\cdot}40 \pm 0{\cdot}11$ μgm. per gm. (four experiments).

There is thus no evidence that freezing is associated with a loss of acetylcholine; it is possible that the results of Elliott and Henderson[5] were due to their allowing some thawing of their frozen tissue before its acetylcholinesterase had been completely inactivated, for acetylcholine disappears very rapidly from frozen tissue if even momentary thawing is allowed to occur[3].

Finally, the acetylcholine content of the brains of a series of sixteen adult rats, killed by immersion in liquid air, was found to be $2{\cdot}52 \pm 0{\cdot}15$ μgm./gm., while the excised brains of litter mates of five of these animals contained only $1{\cdot}82 \pm 0{\cdot}02$ μgm./gm. There seems to be no loss of acetylcholine from excised brain during the first few minutes after decapitation, and it would appear that the low content of acetylcholine in the excised brain resulted from the effects of the violent stimulation accompanying the process of decapitation. It is evident that such an effect could mask any but marked differences in the concentration of acetylcholine in the brains of animals subjected to different experimental procedures. For the detection of such differences, as well as for the determination of the absolute acetylcholine content of the brain, the use of liquid air would seem to remain the method of choice.

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Passive Transfer of Transplantation Immunity

PASSIVE transfer of transplantation immunity has never been successfully achieved in a simple way. Previous demonstrations of passive transfer have either employed special techniques giving results which are difficult to interpret[1,2], or else the nature of the immunity has been in doubt[3]. Here is reported

a simple procedure for passively transferring transplantation immunity to a tumour.

The tumour used was lymphosarcoma *6C3HED*, described by Gardner, Dougherty and Williams[4]. Mice of Strong's *CBA* line are uniformly susceptible to the tumour, and mice of Strong's *C57* line, and the *Ai* line inbred in this laboratory, are uniformly non-susceptible. The survival of grafts of the tumour in non-susceptible mice has been measured by allowing grafts of the tumour to lie in these mice, and then regrafting them into susceptible mice, where growth of the tumour indicates that the tumour had survived in the non-susceptible host. In this way the median survival time of the tumour in *Ai* mice was found to be $9 \cdot 9 \pm 0 \cdot 8$ days. If the *Ai* mice had been previously immunized by inoculation with the tumour, the median survival time was then $2 \cdot 1 \pm 0 \cdot 3$ days. In order to demonstrate passive transfer of transplantation immunity, tissues were transferred from immunized non-susceptible mice into non-susceptible mice from the same line, and the proportion of test grafts of the tumour which survived after eight days in these hosts was measured. Approximately 70 per cent of the grafts survived this time in untreated non-susceptible mice, and after successful transfer of immunity this proportion was reduced.

Subcutaneous inoculations of serum and peritoneal exudate from immune mice both proved ineffective in transferring immunity, in experiments with *Ai* mice. However, evidence was obtained for transfer of immunity by intraperitoneal transplantation of 'immune' lymph nodes, and further investigations of this method of transfer were carried out in *C57* mice. Lymph nodes from immune mice were found to be highly effective in transferring immunity.

This method of transfer could be shown to be genuinely passive, and not merely a transfer with the lymph nodes of tumour cells or possibly of isoantigenic particles. Immune lymph-node mince was inoculated into *CBA* mice, but invariably failed to give rise to tumours. Furthermore, the duration of the immunity was estimated by leaving intervals between inoculation of immune lymph nodes and test tumour grafts. The immunity appeared to remain firm for four days, weaken after ten days, and disappear after twenty days. Lymph nodes taken from non-susceptible mice ten days after inoculation with the tumour were effective in transferring immunity, but after twenty days this power was lost. At this time all the tumour cells had been killed, and the nodes, which after ten days hypertrophy to approximately double their normal weight, have almost returned to normal. Only local lymph nodes were effective in transferring immunity; the corresponding nodes from the opposite side to the site of tumour inoculation were not effective. Neither spleen nor muscle from immunized mice was found to be effective.

This investigation, which will be published elsewhere in detail, shows that transplantation immunity shares with immunity to simple organic compounds[5] and immunity to tuberculin[6] the property of being transferred with greater facility by cells than by serum.

I wish to thank Prof. P. B. Medawar and Dr. K. B. Roberts for much helpful advice and discussion.

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Hyaluronidase and Salicylates

It has been shown by Hechter[1] that, in the living animal, the spreading effect of hyaluronidase depends upon several factors. Inhibition of this effect such as has been reported to result from the administration of salicylates[2] may not therefore be due, necessarily, to depression of enzyme activity. The effect of hyaluronidase upon the permeability of connective tissue may be demonstrated on pieces of isolated fascia *in vitro*[3]. This method may be expected to give an indication of the action of hyaluronidase alone, since other factors which complicate the phenomenon of spread *in vivo* are excluded.

Three white stock mice, two male and one female, each weighing 25 ± 2 gm., were given 1 per cent sodium salicylate in their drinking water for 48 hr.; in addition, 0·5 ml. of 1 per cent sodium salicylate was injected intraperitoneally 24 hr. and again from between 1 and 6 hr. before the end of this period. The mice were then killed and fascia from each was immediately moistened with 1 per cent sodium salicylate, *p*H 6·1, and fixed as an occluding membrane to the end of a glass tube in the way previously described[3]. The membrane was immersed in the same solution, and more solution was passed through it at a pressure of 4 cm. water. After a few minutes the rate of flow was measured. A solution of Benger's 'Hyalase' in 1 per cent sodium salicylate was then perfused and after two minutes the rate of flow was measured again. Each mouse provided two membranes, one from each flank; but one membrane was damaged in dissection and not used. As a control, five membranes were obtained from three mice to which no salicylate had been given but which were similar in other respects. Rates of flow before and after perfusion of hyaluronidase were measured exactly as before, except that 0·85 per cent sodium chloride, *p*H 5·6, was substituted for salicylate. The results are shown in the accompanying table.

The table shows that the increase of flow produced by hyaluronidase is of the same order in both groups. In view of the very great increase in rate of flow brought about by the enzyme in the presence of salicylate and, moreover, through tissue from animals to which salicylate had been copiously administered, it is hard to believe that salicylates can have any

	Experimental					Control				
	1	2	3	4	5	1	2	3	4	5
Initial rate of flow (μl./sec.)	0·47	1·05	0·36	0·44	0·47	0·7	1·17	1·7	1·3	0·85
Rate of flow after hyaluronidase (μl./sec.)	10·0	16·0	6·6	13·6	10·0	20·0	20·0	20·0	20·0	11·0
Increase (×)	21	15	18	31	21	29	17	12	15	13

significant inhibiting effect upon the action of hyaluronidase on connective tissue. The explanation of their inhibition of the spreading phenomenon *in vivo* is therefore probably referable to their influence upon some other of the several factors upon which this phenomenon depends.

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Position of Radical Attack during Oxidation of Long-Chain Paraffins

Much work has been done on the liquid-phase oxidation of hydrocarbons; but strangely enough very few experiments of a fundamental nature have included what would appear to be the simplest models, namely, straight-chain paraffins. Any suggestions made so far concerning the point of oxygen attack when there is no preferred tertiary or activated hydrogen atom have been largely speculative. Ivanov *et al.*[1] claim, on the basis of certain products isolated from the oxidation of *n*-heptane, that attack takes place predominantly at the 2-position. Asinger[2] found that in the chlorination of dodecane and cetane attack was equal on all methylene groups, and suggested that the same would hold for oxidation.

In our research on the mechanism of liquid-phase oxidation of paraffins, we have determined the proportion of attack on the different carbon atoms of *n*-decane.

Pure *n*-decane was autoxidized at 145° C. with oxygen until the hydroperoxide concentration had reached 2·5 per cent w/w. From previous work in these laboratories it was known that at this extent of oxidation more than 80 per cent of the decane oxidized retains its original carbon skeleton, the oxygen being present as hydroperoxy- and carbonyl-groups; of these functional groups, 80 per cent are present in mono-functional compounds, the isomer distribution of which indicates the points of attack.

The oxidate was first hydrogenated on palladium black to reduce the hydroperoxides to the corresponding alcohols. In one case the oxygenated compounds were then separated from the unchanged hydrocarbon by chromatography and treated with lithium aluminium hydride to reduce the ketones to alcohols, thus yielding a mixture (*A*) of the total isomers from which the diols had to be removed.

Samples of the same hydrogenated oxidate were also subjected to chromatography by two different operators to separate hydroperoxide-derived alcohols (B_1 and B_2) from ketones. The two ketone fractions, on reduction with $LiAlH_4$, yielded isomeric decanol mixtures (C_1 and C_2). During chromatography a partial resolution of the isomeric alcohols was noted.

The infra-red spectra of all five mixtures were recorded and the proportion of isomers determined by matching against standard mixtures of the pure decanols. In some cases, for example, C_2, traces of non-decanol material compromised accurate matching.

Mixture *A* should give the more accurate picture since fewer manipulations were involved in this case.

Decanol isomer	Each isomer as percentage of total isomers in the fraction					Limits of accuracy of infra-red analyses
	Decanols from total oxidate	Decanols from peroxides		Decanols from ketones		
	A	B_1	B_2	C_1	C_2	
1-ol	3	Detected	<3	Detected	Not detected	± 2
2-ol	31	28	29	25	22	± 3
3-ol	25	28	28	22	[35]	± 3
4-ol	22	22	17	25	22	± 5
5-ol	19	22	23	28	22	± 3

The sum of *B* and *C* in the correct proportions is in reasonable agreement with *A*. Part of the ketones may have arisen from the hydroperoxide during hydrogenation; after allowing for this, and considering the limits of accuracy of analysis, we believe that the isomeric distribution of the ketones is substantially the same as that of the hydroperoxides.

By continuous counter-current extraction, decane monohydroperoxide of purity greater than 97 per cent was isolated from an *n*-decane oxidate prepared at 145° C. The isolated peroxide, which contained 20 per cent of the oxygen absorbed, was hydrogenated over Adams's catalyst and the product was an equimolar mixture of the four secondary decanol isomers with possibly a trace of decan-1-ol. No other products could be detected by infra-red spectroscopy.

Our results show that there is a small proportion of attack at the terminal methyl groups, but that the major attack is distributed almost equally on the methylene groups of the *n*-decane chain. Allowing for the limits of accuracy of the infra-red analysis, the preference for the methylene groups near the ends of the chain is only slight.

Our thanks are due to Messrs. Philpotts and Thain for the spectroscopic analyses. This work is part of a joint investigation by the Anglo-Iranian Oil Co., Ltd., and the Distillers Co., Ltd., into the liquid-phase oxidation of paraffins, and we thank our Directors for permission to publish it.

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A Rapid Method for the Extraction of Radioiodide from Urine

The extraction of radioiodide from urine is important in radioiodide therapy, since without it the large quantities of highly radioactive urine which accumulate must be stored until the activity decays sufficiently to allow disposal.

Purves has described[1] a method for removing iodide from boiled, acidified and filtered urine by passing it through a filter bed of asbestos impregnated with silver chloride, the iodide being retained in the filter bed, from which it can be afterwards removed as iodic acid by treatment with a solution of chlorine

in 0·1 *N* sulphuric acid. Our experience with this method has been that in practice it fails because filtration of urine is a slow process, and also the asbestos mat invariably becomes clogged before 100 ml. of urine have passed through. Swiftness and simplicity of operation and an absolute minimum of handling are essential when dealing with highly radioactive solutions, and these considerations led us to evolve the following method, which is a practical improvement on that of Purves.

Silver chloride prepared by precipitation from silver nitrate was washed carefully with distilled water containing 1 per cent of nitric acid to free it from soluble salts. After drying in the dark at 100–110° C., it was fused in a silica dish at 465° C. The melt was allowed to solidify into a cake, removed from the dish by breaking the latter, and grated down with a coarse rasp. Silver chloride so prepared is effective in removing iodide from solutions. Varieties of silver chloride globules and sponges were also made by pouring the melt into cold water, but none of them was effective.

A glass tube of internal diameter 1 cm. and length 25 cm., wrapped in black paper, was filled with granules of silver chloride sieved free of dust. The packing was maintained in position by a plug of glass wool at each end. The urine, contained in the bottles used for collection, is drawn through the column by means of a water pump and discharged into a 2-lit. reservoir from which, after checking that the radioactivity has been removed by the column, it is disposed of down the sink. The extracted radioiodide is found almost completely within the first 2 cm. of the column.

The *p*H of the urine is adjusted to 2·8 with nitric acid using brom-phenol blue as indicator. If this is done as soon as possible after collection, neither boiling nor filtration of the urine is necessary and the extraction of iodide may be postponed, if desired, for 24–72 hr. The rate of flow through the column is limited only by the necessity of avoiding disturbance of the packing and of preventing channelling by gas bubbles produced by reduced pressure. Flow-rates of 100 ml./min. or more may be easily maintained.

The silver chloride preparation appears to be very stable. We have treated as much as 8 litres at a time without reducing the efficiency of the column, and there seems no reason why this figure should not be exceeded. In practice, however, the accumulation of dangerous quantities of radioactivity renders it advisable to decontaminate the column periodically as outlined above. This process also regenerates the silver chloride. We have so far passed more than 30 litres through the column without noticing any falling-off in its performance, as is indicated in the accompanying table. The column was decontaminated following passage of the volumes marked with asterisks.

Volume of urine treated (ml.)	Flow-rate (ml./min.)	Delay before treatment (hr.)	Radioiodide extracted (per cent)
1,500*	100	24	97·8
800*	100	48	78·4
1,000*	25	72	83·9
1,600*	30	72	82·9
3,000	20	48	89·8
1,400	70	48	73·8
3,000	10	48	88·9
750*	100	24	73·9
1,600*	100	24	73·9
3,000*	125	48	97·1

It will be seen that the percentage extraction is considerably lower in some cases than others. Recirculating such urine through the column to remove the unextracted fraction is ineffective. This cannot at present be entirely explained, but is at least partially due to the presence of a variable quantity of protein-bound iodine which occurs in radioiodide–therapy urine, and which the column does not extract. This fraction is insignificant during the early hours of treatment, when the urinary output of radioactivity is at its greatest; and the column is, in fact, at its most efficient with such urine. We consider, therefore, that notwithstanding this limitation, the technique is of value as a practical expedient.

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Spontaneous and Induced Mutation

In his book "Bacterial Physiology" (New York, 1951), Dr. J. Lederberg writes, on page 94: "Not all workers have accepted the duality of adaptation mechanisms. Hinshelwood (1946), for example, has disregarded the selection of spontaneous mutants as an element of bacterial adaptations, apparently in order to bolster the applicability of his system of chemical kinetics to problems of bacterial growth".

The reference is to my short book, "The Chemical Kinetics of the Bacterial Cell" (which is described in its own preface as an "essay" and is not a reference work in any event). Nevertheless, it contains one chapter entitled "Variants" (that is, mutants) and another entitled "Selection" (one section of which is entitled "Superposition of Adaptation and Selection"). On page 193, in connexion with spontaneous and induced changes, it is stated: "It should be emphasized at the outset that one has not necessarily to do here with two competing or mutually exclusive hypotheses. Both types of mechanism may in fact operate in nature". On page 202 it is stated: "From this point of view the question would no longer be: what is the mechanism of variation and adaptation, but, which of the various mechanisms plays the more important part in any given example". On page 203 (in connexion with the same problem) it is stated: "Probably the correct interpretation varies from case to case". Ten pages later, still in the same connexion, it is stated: ". . . one is inclined to feel that a complete gradation of behaviour is probably to be detected, by the proper methods, among bacteria, just as it is known to exist in ordinary chemical reactions, where the relative importance of nucleation and growth of nuclei varies widely".

Experiments in this laboratory have led us to conclude that the induced adaptation mechanism operates in various particular cases. But we have never denied possible or even probable duality of mechanism in general.

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FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, February 9

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE, PHILOSOPHY OF SCIENCE GROUP (in the Joint Staff Common Room, University College, Gower Street, London, W.C.1), at 5.30 p.m.—Dr. G. Kreisel: "On Formalization".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7.30 p.m.—Prof. Gösta Edman: "Ash Pictures in the Identification and Assay of Vegetable Drugs".

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (at the University, Manchester).—Prof. W. A. Deer: "Trends in Petrology" (Percival Lecture).

Tuesday, February 10

UNIVERSITY OF LONDON (in the Anatomy Theatre, University College, Gower Street, London, W.C.1), at 1.15 p.m.—Mr. A. J. Arkell: "Toilet in Ancient Egypt".*

ZOOLOGICAL SOCIETY OF LONDON (at the Zoological Gardens, Regent's Park, London, N.W.1), at 5 p.m.—Scientific Papers.

BRITISH POSTGRADUATE MEDICAL FEDERATION (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.30 p.m.—Dr. Honor B. Fell, F.R.S.: "Organ Culture in Biological and Medical Research" ("The Scientific Basis of Medicine", 11).*

INSTITUTION OF CHEMICAL ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. S. R. Talby and Mr. Muhammed Aly Saleh: "Heat Transfer from Luminous Gas Flames in Vertical Tubes".

INSTITUTION OF MECHANICAL ENGINEERS, AUTOMOBILE DIVISION (joint meeting with the Institution of Electrical Engineers, at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. A. H. Ball and Mr. W. Nethercot: "Ignition Interference with Television Reception".

Wednesday, February 11

ROYAL SANITARY INSTITUTE (at 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Dr. E. A. Parkin: "Problems of Insect Control in Large Kitchens".

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Mr. W. A. Stewart: "Increasing Beef Production"; Mr. W. R. Trehane: "Increasing Milk Production".

UNIVERSITY OF LONDON (at the London Hospital Medical College, Turner Street, London, E.1), at 5 p.m.—Prof. A. Giroud (Paris): "Factors of Abnormal Development".*

UNIVERSITY OF LONDON (at Bedford College, Regent's Park, London, N.W.1), at 5.15 p.m.—Mr. Eric Shipton: "The Recent Everest Expedition" ("Recent Exploration and Discovery", 2).*

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Prof. F. C. Williams, F.R.S., and Mr. G. B. B. Chaplin: "A Method of Designing Transistor Trigger Circuits".

BRITISH INSTITUTION OF RADIO ENGINEERS, LONDON SECTION (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6.30 p.m.—Mr. L. A. Thomas: "Modern Trends in Communications Materials".

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Dr. N. J. Berridge: "The Antibiotic Nisin and its use in the making and processing of Cheese"; Dr. Marie E. Coates: "The Mode of Action of Antibiotics in Animal Nutrition".

Thursday, February 12

ROYAL SOCIETY (at Burlington House, Piccadilly, London W.1), at 4.30 p.m.—Dr. W. J. Pugh, F.R.S.: "The Research Work of the Geological Survey".

BRITISH POSTGRADUATE MEDICAL FEDERATION (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.30 p.m.—Prof. P. C. C. Garnham: "The Life Cycle of the Malaria Parasite" ("The Scientific Basis of Medicine", 12).*

INSTITUTION OF THE RUBBER INDUSTRY (at the Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London, W.1), at 5.30 p.m.—Mr. G. Lynch: "Practical Safety in the Rubber Industry"; at 7 p.m.—Dr. C. M. Blow: "Recent Developments in Chemical Derivatives of Rubber".

UNIVERSITY OF LONDON (at King's College of Household and Social Science, Campden Hill Road, London, W.8), at 5.30 p.m.—Mr. Eric Shipton: "Mount Everest".* (Admission by ticket obtainable from the Secretary of the College.)

BIRKBECK COLLEGE (in the Assembly Hall, Institute of Education, Malet Street, London, W.C.1), at 6 p.m.—Prof. E. G. R. Taylor and Dr. Derek Price: A Discussion on the new Chaucer MS., "The Equatoris of the Planetis".*

Friday, February 13

INSTITUTION OF MECHANICAL ENGINEERS (joint meeting with the HYDRAULICS GROUP, at Storey's Gate, St. James's Park, London, S.W.1), at 10.30 a.m.—Conference on "Hydraulic Servo-mechanisms".

OPERATIONAL RESEARCH CLUB (joint meeting with the ERGONOMICS RESEARCH SOCIETY, in the Large Lecture Room, Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Discussion on "Men and Machines in Transport Systems".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Anniversary Meeting, followed by Annual General Meeting.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Neville Hall, Newcastle-upon-Tyne), at 6.15 p.m.—Mr. J. D. Hislop: "The Role of Non-Destructive Testing in Industry".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Dr. J. W. Mitchell: "Some Experiments on Photographic Sensitivity".

Saturday, February 14

BRADFORD CHEMICAL SOCIETY (at the Technical College, Bradford), at 2 p.m.—Research Colloquium.*

LONDON COUNTY COUNCIL (at the Horniman Museum, London Road, Forest Hill, London, S.E.23), at 3.30 p.m.—Mr. R. D. Barnett: "Cyrene, a Greek City in North Africa".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEPUTY COAL SURVEY OFFICER (with a good honours degree, or equivalent, in chemistry, fuel technology, or geology, preferably with industrial experience and experience in laboratory control) at the Coal Survey Laboratory, Nottingham—The National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, endorsed TT/584 (February 14).

FIRST GRADE ENGINEERING ASSISTANT (sewerage) in the City Engineer's Department, Port Elizabeth—Davis and Soper, Ltd., Agents to the City Council of Port Elizabeth, 52–54 St. Mary Axe, London, E.C.3 (February 14).

GRADUATE ASSISTANT SCIENCE MISTRESS at the Lady Edridge Grammar School, South Norwood, to teach Physics throughout the school to advanced level of the G.C.E.—The Chief Education Officer, Education Office, Katharine Street, Croydon, Surrey (February 14).

SCIENTIFIC OFFICER for research and development work on electronic instrumentation for use in trials of guided missiles (Ref. A.7/53A), an EXPERIMENTAL OFFICER for development and modification of electronic instrumentation used for trials of guided missiles and to supervise the field operation and maintenance of this class of equipment (Ref. A.8/53A), and an ASSISTANT EXPERIMENTAL OFFICER to assist in development, operation, maintenance, calibration, etc., of telemetry equipment (Ref. A.9/53A), at Ministry of Supply Establishment at Aberporth, South Wales—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting the appropriate Ref. No. (February 14).

SCIENTIFIC TECHNICAL OFFICER (Grade II or III) at the Central Laboratory, Shade House, Bolton Road, Pendlebury, interested in the investigational side of coal sampling and preparation—The Divisional Establishment Officer, National Coal Board, North-Western Division, 40 Portland Street, Manchester 1 (February 14).

SCIENTIFIC TECHNICAL OFFICER (Grade II or III) (with a scientific background mainly in chemistry, and able to abstract and translate) as Technical Librarian at the Central Laboratory, Shade House, Bolton Road, Pendlebury—The Divisional Establishment Officer, National Coal Board, North-Western Division, 40 Portland Street, Manchester 1 (February 14).

SPEECH THERAPIST to the Wallington Clinic—The County Medical Officer, County Hall, Kingston-upon-Thames, Surrey (February 14).

RESEARCH ASSISTANT (good honours degree in engineering or science, or its equivalent with a knowledge of aerodynamics and training and aptitude for experimental work essential) IN THE DEPARTMENT OF AERODYNAMICS, to assist in experimental research—The Registrar, College of Aeronautics, Cranfield, Bletchley, Bucks (February 16).

ASSISTANT LECTURER IN GEOGRAPHY—The Secretary, London School of Economics and Political Science, Houghton Street, Aldwych, London, W.C.2 (February 20).

DIRECTOR OF STUDIES AND LECTURER (or ASSISTANT LECTURER) IN GEOGRAPHY—The Secretary, Girton College, Cambridge (February 20).

CONTROL AND SWITCHGEAR ENGINEER in the Mechanical and Electrical Engineering Branch at London headquarters—The National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, quoting TT/589 (February 21).

GENETICIST FOR POULTRY RESEARCH CENTRE, Edinburgh—The Secretary, Agricultural Research Council, 15 Regent Street, London, S.W.1 (February 21).

RESEARCH CHEMIST IN THE SOILS AND PLANT NUTRITION SECTION at Long Ashton Research Station—The Registrar and Secretary, The University, Bristol (February 21).

CHAIR OF PHYSICS APPLIED TO MEDICINE at Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, London, W.C.1 (February 25).

UNIVERSITY DEMONSTRATOR IN AGRICULTURE (with a degree or postgraduate diploma in agriculture and, preferably, trained in field experimentation)—The Secretary, School of Agriculture, Cambridge (February 25).

DEMONSTRATOR AND RESEARCH ASSISTANT IN DENTAL AND ORAL PATHOLOGY—The Registrar, The University, Sheffield (February 28).

I.C.I. RESEARCH FELLOWSHIPS IN BIOCHEMISTRY, CHEMISTRY, ENGINEERING, PHARMACOLOGY, or PHYSICS—The Secretary of University Court, The University, Glasgow (February 28).

LECTURER IN MATHEMATICS—The Secretary of University Court, The University, Glasgow (February 28).

SCIENTIFIC OFFICER (with a good honours degree in mathematics and, preferably, specialized in mathematical statistics or analysis) to assist with mathematical problems arising from research on animal and plant populations—The Establishment Officer (S), Nature Conservancy, 91 Victoria Street, London, S.W.1 (February 28).

STRUCTURAL ENGINEERS in Government Departments—The Secretary, Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S.64–65/53 (February 28).

NUFFIELD FELLOWSHIPS AND SCHOLARSHIPS IN DENTISTRY—The Secretary, Nuffield Foundation, Nuffield Lodge, Regent's Park, London, N.W.1 (Fellowships, March 1; Scholarships, June 30).

LECTURER IN MEDICAL PHYSICS (graduate in physics with research experience and interested in medical problems)—The Registrar, The University, Manchester 13 (March 2).

ROBERT BLAIR FELLOWSHIP for advanced study or research in applied science and technology abroad—The Education Officer, (EO/H1/2), London County Council, County Hall, London, S.E.1 (March 2).

REGIUS CHAIR OF FORENSIC MEDICINE in the University of Edinburgh—The Private Secretary, St. Andrew's House, Edinburgh (March 15).

LECTURER IN PHILOSOPHY—The Dean of Arts and Science, University of Alberta, Edmonton, Alberta, Canada (March 31).

LECTURER IN VETERINARY BIOCHEMISTRY, and an ASSISTANT LECTURER OR LECTURER IN VETERINARY MEDICINE (farm animals)—The Registrar, The University, Liverpool (March 31).

PUPILS and PROBATIONERS IN CIVIL ENGINEERING, and PUPILS IN MECHANICAL AND ELECTRICAL ENGINEERING (including telecommunications), in the Colonial Engineering Service, mainly in West, East and Central Africa, Malaya and the Far East—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE/100/011 (March 31).

BIOLOGICAL SCHOLARSHIPS AND BURSARIES—The Secretary, Nuffield Foundation, Nuffield Lodge, Regent's Park, London, N.W.1 (April 1).

I.C.I. RESEARCH FELLOWSHIPS IN BACTERIOLOGY, BIOCHEMISTRY, BIOMOLECULAR STRUCTURE, BOTANY (plant biochemistry), CHEMICAL ENGINEERING, CHEMISTRY, CHEMISTRY OF LEATHER MANUFACTURE, CHEMOTHERAPY, COLOUR CHEMISTRY AND DYEING, ENGINEERING (civil, electrical or mechanical), FUEL AND REFRACTORIES, GEOLOGY (including geochemistry), METALLURGY, MINING (selective flotation and geophysical surveying), PHARMACOLOGY, PHYSICS, PHYSIOLOGY, or TEXTILE INDUSTRIES (protein chemistry)—The Registrar, The University, Leeds 2 (April 20).

I.C.I. FELLOWSHIPS FOR RESEARCH IN CHEMISTRY, PHYSICS and allied subjects—The Registrar, The University, Manchester 13 (April 30).

I.C.I. FELLOWSHIPS FOR RESEARCH IN PHYSICS, CHEMISTRY, BIOCHEMISTRY, ENGINEERING, METALLURGY, PHARMACOLOGY, CHEMOTHERAPY, or related subjects—The Secretary of the Board of Research Studies, The Old Schools, Cambridge (April 30).

I.C.I. RESEARCH FELLOWSHIPS IN BIOCHEMISTRY, CHEMISTRY, CHEMOTHERAPY, ENGINEERING, METALLURGY, PHARMACOLOGY, PHYSICS or allied subjects—The Academic Registrar, University of London, Senate House, London, W.C.1 (April 30).

MR. AND MRS. JOHN JAFFE DONATION for a studentship in original scientific research—The Assistant Secretary, Royal Society, Burlington House, Piccadilly, London, W.1 (April 30).

SOCIOLOGICAL SCHOLARSHIPS AND BURSARIES—The Secretary, Nuffield Foundation, Nuffield Lodge, Regent's Park, London, N.W.1 (May 1).

CIVIL ENGINEERS in Government Departments—The Secretary, Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S.64–65/53 (June 30).

ASSISTANT PHYSICIST—The Secretary, Board of Management for Glasgow Western Hospitals, 10 Park Circus, Glasgow, C.3.

BOTANIST (Plant Breeder) at Rokupr Rice Research Station, Sierra Leone—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting No. 27059/317.

CHIEF RESEARCH AND DEVELOPMENT OFFICER (with an honours degree in mining or science, and research and practical mining experience), Mines Department, Federation of Malaya—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.99/60/03.

CROP ECOLOGIST in the Department of Soil and Land Use Survey, Gold Coast, to collect yield data for various crops grown on different soils—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.79/13/03.

ELECTRICAL ENGINEERS and PHYSICISTS at the Ministry of Supply Telecommunications Research Establishment, Malvern: SCIENTIFIC OFFICER grade (Ref. A.5/53A) and EXPERIMENTAL and ASSISTANT EXPERIMENTAL OFFICER grades (Ref. A.6/53A) for research and development work on radio and electronic equipment in the Radar, Physics and Engineering Departments—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting the appropriate Ref. No.

ENGINEER (honours degree in mechanical engineering preferred) for research on new drives and designs for textile machines—The Wool Industries Research Association, Torridon, Headingley, Leeds 6.

EXECUTIVE ENGINEER in the Public Works Department, Uganda, to be responsible for construction and maintenance of roads, housing schemes, water supply, drainage, sewerage, and buildings—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.112.9/02.

EXPERIMENTAL OFFICER IN THE MECHANICAL ENGINEERING RESEARCH LABORATORY of the Department of Scientific and Industrial Research, East Kilbride, Glasgow, for research on plastic deformation of metals occurring in commercial processes, for example, rolling, drawing and forging—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.153/52A.

EXPERIMENTAL OFFICERS (with a pass degree in geology, mining, engineering or physics) for field work in Uganda, including supervision of examination of mineral deposits by pitting, trenching, shallow drilling and sampling; also some surveying and laying out of prospecting areas and collation of records—The London Director, Uganda Development Corporation, Ltd., 27 Regent Street, London, S.W.1.

EXPERIMENTAL OFFICERS IN THE RADIO DIVISION, Royal Aircraft Establishment, Farnborough, on development of electronic equipment, for radio frequency measurements, especially at centimetric wave-lengths, and for other detailed technical investigations—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting D.1/53A.

EXPERIMENTAL OFFICERS or ASSISTANT EXPERIMENTAL OFFICERS at the National Physical Laboratory, Teddington, for experimental work in the Ship Division—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting C.14/53A.

GEOLOGISTS (with a university degree in geology with first- or good second-class honours) in the Colonial Geological Survey Service—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.104/04.

LECTURER (with a good honours degree with some teaching or industrial experience, and preferably with a special interest in electronics or electroacoustics) IN THE PHYSICS DEPARTMENT—The Principal, Northampton Polytechnic, St. John Street, London, E.C.1.

METEOROLOGICAL OFFICER (with a first- or second-class honours degree in mathematics or physics, preferably with experience as a meteorologist) in Nyasaland—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.98/4/01.

METEOROLOGISTS in the British Caribbean Meteorological Service—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.57/26/01.

ORGANIC CHEMIST (Ph.D. preferred) in the Chemical Research Laboratory, Rheumatism Research Unit, to work with a team in the steroid field—W. Stansfield, Lyndhurst, Nether Edge Hospital, Sheffield 11.

PETROLOGIST (with an honours degree in geology with a specialist qualification in petrology, and one year's postgraduate study or experience) in the Gold Coast, for petrological investigations in field and laboratory, with chemical analysis of rocks and minerals—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting CDE.105/13/02.

PHYSICIST (with a good honours degree; an interest in statistical methods is desirable) for work concerned initially with the processing of textile fibres both from a practical and theoretical point of view—The Secretary, British Jute Trade Research Association, Kinnoull Road, Kingsway West, Dundee.

PHYSICIST (with a first- or second-class honours degree or equivalent in physics, and interested mainly in electromagnetic theory) in a Ministry of Supply establishment at Malvern, as theoretician on problems connected with design of high energy accelerators, with personal charge of a full-time computer—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A.23/53A.

PHYSICISTS or ENGINEERS at the Royal Aircraft Establishment, Farnborough, to work on problems connected with either generation and distribution of electric power in aircraft, or on problems of electrotechnology arising in design and development of aeronautical equipment (Ref. D.6/53A); ENGINEER with extensive electronic or electrical experience for development work on the application of electronic and electrical equipment to flight vibration testing of aircraft (Ref. D.7/53A)—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting the appropriate Ref. No.

PHYSICS GRADUATE for research in the strength of paper and board—The Printing, Packaging and Allied Trades Research Association, Randalls Road, Leatherhead, Surrey.

POSTGRADUATE STUDENTSHIP IN PLANT BREEDING, ENTOMOLOGY AND PLANT PATHOLOGY—The Secretary, Empire Cotton Growing Corporation, 12 Chantrey House, Eccleston Street, London, S.W.1.

PROFESSIONAL ENGINEERS in various Government Departments, in a wide variety of engineering duties—The Secretary, Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S.85/53.

SCIENCE or ENGINEERING GRADUATES for research in the CHEMICAL ENGINEERING DEPARTMENT on some aspects of flow of liquids through porous materials—The Registrar, Imperial College of Science and Technology, South Kensington, London, S.W.7.

SENIOR LECTURER IN CHARGE OF THE ELECTRONICS WORK OF THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Secretary, Royal Technical College, George Street, Glasgow.

SENIOR SCIENTIFIC OFFICER at Capenhurst, Chester, for analytical and vacuum technique development and work involving mass transfer in polyphase systems—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs, quoting Ref. 410.

SENIOR TECHNICAL OFFICER (with a degree in horticulture or botany or equivalent qualification, with suitable practical experience in postgraduate training in research) for Seed Production of Vegetable and Root Crops—The Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

SURVEYORS in the Gold Coast Local Civil Service for geodetic, topographical and cadastral surveys and the supervision of junior staff—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting DE.103/13/01.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Forestry Commission. Report on Forest Research for the Year ending March 1951. Pp. vi+139+4 plates. 4*s.* 6*d.* net. Bulletin No. 19: Poplars. By T. R. Peace. Pp. iv+50+24 plates. 7*s.* 6*d.* net. Leaflet No. 30: Sooty Bark Disease of Sycamore, *Cryptostroma corticale*. Pp. 8. 9*d.* net. (London: H.M. Stationery Office, 1952.) [261]

Southern Regional Council for Further Education. Fifth Annual Report, October 1952. Pp. 36. (Reading: Southern Regional Council for Further Education, 1952.) [271]